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ABSTRACT

This report presents the results of a review of engineering programs offered at the universities governed by the Board of Regents of the State University System of Florida conducted by a team of engineering consultants. It begins with comments on recent and current trends in engineering employment and education, followed by a discussion of several significant system-wide issues, reviews of the individual campuses, and a summary of major findings and recommendations. The individual campuses include: University of Florida (UF), Florida A&M University and Florida State University joint engineering school (FAMU/FSU), University of South Florida (USF), Florida Atlantic University (FAU), University of Central Florida (UCF), Florida International University (FIU), and University of North Florida (UNF). Information listed under individual campuses includes educational programs, students, faculty, facilities and resources, responses to previous program review recommendations, strengths and needs, and recommendations. The report does not include Computer Engineering programs. Although the review was not conducted at the level of detail of a professional accreditation review, reference is made from time to time to the potential impact of certain features of a particular program on its continued accreditation by the Accreditation Board for Engineering and Technology (ABET). (JRH)

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ENGINEERING EDUCATION PROGRAM REVIEW

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STATE UNIVERSITY SYSTEM OF FLORIDA

October, 1995

BOR 94-4

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State University System of Florida
Engineering Education Program Review

October 1995

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ENGINEERING PROGRAM REVIEW
STATE UNIVERSITY SYSTEM OF FLORIDA
OCTOBER/NOVEMBER 1994

Introduction

In October and November, 1994, a team of engineering consultants conducted a review of engineering programs offered at the universities governed by the Board of Regents of the State University System of Florida (SUS) in accordance with a Program Review Policy established by the Board in 1975 and subsequently enacted into law (1983) by the Florida Legislature. This was the third engineering review carried out under the Policy and followed earlier reviews in 1982 and 1988. The membership of the consultant team is given in Appendix A.

At present, engineering programs are offered at eight of the nine universities of the SUS:

1. University of Florida (UF),
2. Florida A&M University and Florida State University joint engineering school (FAMU/FSU),
3. University of South Florida (USF),
4. Florida Atlantic University (FAU),
5. University of Central Florida (UCF),
6. Florida International University (FIU), and
7. University of North Florida (UNF).

This report presents the results of the review, beginning with comments on recent and current trends in engineering employment and education, followed by a discussion of several significant system-wide issues, reviews of the individual campuses, and a summary of major findings and recommendations. The report does not include the SUS Computer Engineering programs (CIP 14.0901). Although the review was not conducted at the level of detail of a professional accreditation review, reference is made from time to time to the potential impact of certain features of a particular program on its continued accreditation by the Accreditation Board for Engineering and Technology (ABET).

Trends in Engineering Employment and Education

Engineering Employment

Over the past five years, the environment for engineering practice in the United States has undergone revolutionary changes, which are only now beginning to be understood by American engineers and engineering educators. The end of the Cold War has drastically reduced the demand for engineering services in defense related industries, while global competition is forcing commercial-sector employers to downsize their workforces, including the elimination of many middle-management positions, which frequently offered a natural avenue of career progression for engineers. Advances in information and communications technologies now permit real-time, interactive cooperation by engineers and managers from different parts of the world on a single project, allowing engineering work to be "imported" from countries offering high-quality services at a significant cost advantage over similar services in the US; for example, India, Eastern Europe, and the former Soviet Union.

As a result, engineering employment patterns are shifting rapidly in many fields, away from the large manufacturing firms and toward smaller manufacturers and engineering service companies. These shifts, combined with the frequency of corporate mergers and spin-offs, are creating an environment where a lifetime career with a single employer, once the normal expectation of an engineering graduate, becomes less likely. Over the past three years, more and more engineering graduates have been unable to find employment through traditional on-campus interviews by large firms and have had to exercise considerable initiative in making individual, direct contacts with smaller firms to explore job opportunities.

Many observers believe that the new environment reflects a fundamental structural change in engineering employment patterns, not merely an extension of past cyclic trends. Although forecasts of future employment demand are notoriously unreliable, it seems reasonable to expect that the growth of engineering employment over the next decade may be significantly less than predicted in recent years. Furthermore, the intellectual skills needed by the majority of future engineering graduates may differ significantly from those needed in the past, calling for a restructuring of engineering education.

Engineering Education

Through World War II, engineering was taught as a highly practical subject with little application of mathematics beyond elementary calculus and emphasis on design according to codes and other well-defined methods. However, over the next decade, engineering education underwent a profound change, or paradigm shift. The traditional methods had proved inadequate to deal with demands on the engineering profession imposed by the new wartime technologies, *e.g.*, radar, jet aircraft, atomic energy, mass production of penicillin, synthetic rubber, and high-octane gasoline. To contribute to these developments successfully, engineers required a much stronger education in mathematics, basic sciences, and engineering sciences than had been provided by most pre-war curricula. Engineering programs responded quickly to these demands, spurred on by new sources of federal funding for science-oriented research. Courses in shop, mechanical drawing, and (except in civil engineering) surveying disappeared, to be replaced by differential equations, control systems theory, and transport phenomena. At some institutions, the so-called engineering curriculum became difficult to distinguish from one in applied science. Also, at many institutions, externally-funded research productivity became the primary basis for faculty rewards, with consequent reduction of attention to educational effectiveness and innovation, especially at the baccalaureate level.

Few would deny that the engineering science approach has produced graduates with strong technical skills. However, these graduates are not nearly so well prepared in other skills needed for success in today's engineering practice and in the development and management of innovative technology; such skills include: (1) oral and written communication, (2) ability to work effectively as a member of a team, (3) acceptance of ethnic and gender diversity in co-workers, supervisors, and subordinates, and (4) understanding the significance of external forces such as economic constraints, social and environmental impact, and safety and health restrictions that exert a profound impact on both engineering and business decisions. Industry leaders and forward looking educators are calling for another paradigm shift in engineering education that will prepare graduates to function as technical leaders in the quality-oriented, customer-focused, team-based environment that will be essential for industrial survival in the global economy of the 21st Century.[1]

The new paradigm must not abandon the solid mathematical and scientific base of today's engineering curricula, but must introduce engineering subjects in ways that actively engage students in team efforts to address design problems typical of a quality-oriented industrial environment. This suggests much less reliance on traditional lectures and greatly increased emphasis on projects and case studies, with interdisciplinary teams of engineering and (in some cases) business students working on projects that integrate design, development, manufacturing, and marketing of quality products and processes. Engineering sciences might be introduced in modules as needed to support the project, but as a means to an end, not as ends in themselves. Integration of instruction in mathematics, science, and engineering could help reduce the duplication and fragmentation of subject coverage typical of current curricula and provide more effective support for the projects. Earlier introduction of engineering design experiences and adaptation of instruction to different learning styles would be structured to increase student interest and successful progression to graduation, especially among groups currently underrepresented in engineering: women, certain minorities, and individuals with disabilities.

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[1] See, for example, the report "Engineering Education for a Changing World" prepared as a joint study project of the Engineering Deans Council and Corporate Roundtable of the American Society for Engineering Education (ASEE), October 1994; Available from ASEE, 1818 N Street, N.W., Suite 600, Washington, DC 20036.

Such revolutionary changes in educational strategy will require a significant culture change among engineering, science, and mathematics faculty. It will also require additional resources to allow much greater individual attention to students and to reduce the current heavy dependence on external research funding at many engineering schools. Recognizing the need for strong incentives for change, the National Science Foundation (NSF) has established the Engineering Education Coalitions Program to support the development of new models of engineering education at selected groups of engineering schools and the diffusion of successful models among the schools of a given Coalition and beyond. Each Coalition receives NSF funding of approximately $3 million per year for a five-year initial period, with possible extension for a second five years. Dollar-for-dollar matching funds must be provided by the institutions themselves, together with industrial partners, giving a total funding level for each Coalition of $6 million per year. At present the joint Florida A&M University/Florida State University Engineering School and the University of Florida are members of the Southeastern Universities Coalition for Cooperation in

Engineering Education Development[2] (SUCCEED); Florida International University participates in the Gateway Coalition[3]. Both of these Coalitions are now in the third year of their initial five-year funding periods. The significance of these shifting patterns of engineering education and practice for the SUS engineering schools will be discussed in subsequent sections of this report.

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[2] Other institutions in the SUCCEED Coalition are Clemson, Georgia Tech, North Carolina A&T, North Carolina State, University of North Carolina at Charlotte, and Virginia Tech.

[3] Other institutions in the Gateway Coalition are Case-Western Reserve, Columbia, Cooper Union, Drexel, NJ Institute of Technology, Ohio State, Polytechnic, South Carolina, and Pennsylvania.

System-Wide Issues

Enrollment and Graduation Trends

Data provided by SUS staff show that over the five year period from 1989 through 1993, undergraduate headcount enrollments at SUS engineering schools increased by 12.0 per cent and graduate enrollments by 45.2 per cent. From the 1989-90 through 1993-94 school years the number of baccalaureate engineering degrees awarded increased by 5.4 per cent, the number of master's and professional degrees increased by 49.4 per cent, and the number of doctoral degrees increased by 21.5 per cent. Five-year trends can be seen from the tables in Appendices B and C. This growth reflects the continuing growth of Florida's population and the corresponding overall growth in enrollments in the universities of the SUS. However, it may not be matched by corresponding growth in engineering employment opportunities, as suggested above. Engineering graduates join a pool of potential employees that is primarily national, not regional, and hence national, rather than regional, economic forces are the primary factors that determine engineering job demand.

Both local and national job placement activity need to be monitored by engineering deans and others responsible for counseling prospective engineering students and planning enrollment capacity.

Diversity of Engineering Students and Graduates

Data provided by the SUS staff on fall-semester, headcount engineering enrollments by level, gender, and race are tabulated in Appendix B for the five-year period 1989 through 1993. Five-year data on degrees granted by level, gender, and race appear in Appendix C for academic years 1989-90 through 1993-94. These data reveal increased proportions of women and underrepresented minorities among engineering students and graduates in certain areas, but little if any change in others. The following summary tables highlight these trends. Details for the individual institutions are given in the tables of Appendices B and C.

SUS fall-semester, undergraduate engineering headcount enrollments are listed below for the five-year period 1989-93.

Year	total	per cent women	per cent black	per cent Hispanic
1989	9,983	16.0	9.6	12.1
1990	10,267	16.9	11.0	12.4
1991	10,456	17.7	12.5	13.2
1992	10,678	18.5	13.2	12.8
1993	11,181	18.5	14.2	13.1

The continuing growth of African American undergraduate enrollment is encouraging and the levels are well above the national average. However, the earlier growth in percentages of women and Hispanic American students appears to have leveled out.

Fall semester, graduate engineering headcount enrollments are tabulated below.

Year	total	per cent women	per cent black	per cent Hispanic
1989	2,218	12.1	2.3	4.2
1990	2,455	12.2	2.5	4.8
1991	2,434	12.7	2.5	5.1
1992	2,724	13.1	3.0	5.6
1993	2,768	14.0	3.0	6.1

Slow but steady growth in percentages of underrepresented groups among engineering graduate students can be seen, although the percentage of African Americans appears to be leveling off.

Baccalaureate engineering degrees granted by SUS institutions over the five most recent academic years are listed below, with the percentages of underrepresented groups shown.

Year	total	per cent women	per cent black	per cent Hispanic
89-90	1,495	16.1	4.1	11.8
90-91	1,565	15.9	3.8	11.4
91-92	1,530	13.5	5.0	12.9
92-93	1,585	18.1	6.1	13.1
93-94	1,575	17.3	7.0	12.3

These data show a general pattern of growth for all underrepresented groups, with year-to-year fluctuations. Of concern, however, is that the percentage of African Americans among engineering baccalaureate degree recipients is only about half their percentage among undergraduates, while those for women and Hispanic Americans are roughly equal.

Similar data for master's degrees are as follows.

Year	total	per cent women	per cent black	per cent Hispanic
89-90	518	14.9	3.1	3.5
90-91	528	11.4	1.5	3.2
91-92	605	15.0	2.3	5.0
92-93	752	14.2	3.6	5.5
93-94	774	15.0	1.8	6.7

These data include a small number of post-baccalaureate professional degrees, "Chemical Engineer," "Civil Engineer," etc., awarded from time to time; however they do not constitute any significant fraction of the totals. The data show considerable fluctuation from year to year, reflecting the small numbers of degrees awarded annually to each underrepresented group. The only clear trend is the growth in percentage of Hispanic Americans receiving engineering masters and professional degrees. The percentage of each underrepresented group awarded such degrees appears comparable with the percentage of that group in the total graduate enrollment from year to year.

Summary data for engineering doctoral degrees are as follows.

Year	total	per cent women	per cent black	per cent Hispanic
89-90	93	5.4	0.0	1.1
90-91	103	17.5	3.9	2.9

91-92	105	8.6	1.9	3.8
92-93	104	7.7	3.8	2.9
93-94	106	6.2	0.9	0.0

The extremely small numbers of engineering doctoral degrees awarded to those from underrepresented groups leads to large year-to-year fluctuations and precludes identification of any significant trends.

The contributions of each SUS institution to baccalaureate, master's and doctoral engineering degrees over the five year period, 1989-90 through 1993-94 are shown in the following three tables, which include the percentages of underrepresented groups at each level. For bachelors degrees over the five year period:

SUS Inst.	BS engr 89-90 through 93-94	per cent of SUS total BS engineering degrees awarded to			
		total	women	black	Hispanic
FSU/FAMU	824	10.6	12.8	39.2	4.5
FAU	655	8.5	7.6	11.9	8.9
FIU	776	10.0	8.8	11.7	43.7
UF	2,735	35.3	35.5	22.3	24.6
UCF	1,365	17.6	17.4	4.5	7.3
UNF	8	0.1	0.0	0.2	0.0
USF	1,387	17.9	17.8	10.2	10.9
TOTAL	**7,750**	**100.0**	**100.0**	**100.0**	**100.0**

An indication of the relative success of each institution in attracting and retaining to graduation, members of underrepresented groups, may be obtained by comparing the percent of total engineering baccalaureate degrees granted to members of each group with the percent of SUS BS engineering degrees awarded by that institution over the five year period. It will be seen that institutions graduating members of these groups at rates higher than their total degree productivity are FAMU/FSU and UF for women, FAMU/FSU, FAU, FIU, and UNF for African Americans, and FAU and FIU for Hispanic Americans. Particularly notable have been the contribution of FAMU/FSU for African American engineers and that of FIU for Hispanic American engineers.

Similar five-year data for master's and professional degrees are shown in the following table.

SUS Inst.	MS engr 89-90 through 93-94	per cent of SUS total MS/professional engineering degrees awarded to			
		total	women	black	Hispanic
FSU/FAMU	157	4.9	3.3	16.5	3.2
FAU	279	8.8	7.1	1.3	7.6
FIU	125	3.9	3.8	7.6	21.5
UF	1,347	42.4	34.6	39.2	28.5
UCF	596	18.8	25.7	10.1	13.9
UNF	0	0.0	0.0	0.0	0.0
USF	673	21.2	25.5	25.3	25.3
TOTAL	**3,177**	**100.0**	**100.0**	**100.0**	**100.0**

Institutions awarding engineering master's degrees to higher proportions of underrepresented groups than their proportions of total SUS graduates are UCF and USF for women, FSU/FAMU and USF for African Americans, and FIU and USF for Hispanic Americans.

Five-year engineering doctoral degree data are as follows.

SUS Inst.	PhD engr 89-90 through 93-94	per cent of SUS total doctoral engineering degrees awarded to			
		total	women	black	Hispanic
FSU/FAMU	5	1.0	0.0	0.0	0.0
FAU	48	9.3	10.6	0.0	9.1
FIU	0	0.0	0.0	0.0	0.0
UF	378	73.0	66.0	90.9	45.5
UCF	35	6.8	12.8	0.0	27.3
UNF	0	0.0	0.0	0.0	0.0
USF	52	10.0	10.6	9.1	18.2
TOTAL	**518**	**100.0**	**100.0**	**100.0**	**100.0**

Institutions awarding engineering doctoral degrees to higher proportions of underrepresented groups than their proportions of total SUS graduates are FAU, UCF, and USF for women, UF for African Americans, and UCF and USF for Hispanic Americans. It is also important to note that at both the master's/professional and doctoral levels UF grants the largest numbers of degrees to women, African Americans, and Hispanic Americans. The numbers of doctoral degrees awarded to these groups over the five year period were quite small: for women 47 total, 31 at UF; for African Americans 11 total, 10 at UF; and for Hispanic Americans 11 total, 5 at UF.

The data presented above point to the need for significant additional efforts by SUS engineering schools to recruit and retain to graduation members of underrepresented groups at all degree levels. In addition, the apparently low graduation rates of African American minorities in comparison with those of other groups suggest a need for additional academic and personal support for such students to improve their rates of retention and progression to graduation.

Limited Access Programs

The consultant team encountered confusion as to what constitutes a "limited access" program as defined by the SUS. A majority of the engineering programs reviewed have requirements for admission to upper division engineering work that include an overall grade point average of at least 2.0 (out of 4.0) with at least 2.5 in certain pre-engineering technical courses (mathematics, physics, and chemistry). Experience has shown that students who fail to perform at least at this level have very small likelihood of completing an engineering degree program successfully. However, at some SUS institutions these requirements were considered to constitute "limited access," while at others they were not.

In the opinion of the consultant team, requirements such as those above are reasonable, consistent with the experience of many engineering schools as predictors of success in engineering study, and not imposed for the purpose of limiting enrollments to any specific numbers. Absent an additional restriction on the actual numbers of students admitted to a program, these modest performance requirements should not cause a program to be designated as "limited enrollment."

Degree Credit Hour Requirements (Accountability Measure 12)

Accountability Measure 12 of the State of Florida specifies 120-128 semester credit hours as the desired hour range for an undergraduate degree. After careful review by the responsible faculties and administrators, a number of SUS engineering programs have reduced credit hour requirements to fall within this range. Where the desired maximum of 128 hours is exceeded, the larger number of credits does not result from excessive engineering, mathematics, or science credits, which are quite comparable to those of other accredited engineering programs in the United States. However, as noted in the campus reports, many SUS institutions have non-technical general education and completion requirements greater than those typical of US engineering programs. Taken together, the necessary engineering coursework and the institutionally mandated general education coursework require more than 128 credit hours to complete.

Program-to-program variations in credit hour requirements can be explained by the institutional variations in general education requirements and by the special accreditation requirements of certain disciplines, for example, chemical engineering, which include 16 credits of advanced chemistry beyond the other ABET curricular requirements.

In the opinion of the consultant team, further reductions in credit hours below current levels are not justified and could, in many instances, jeopardize program quality and accreditability.

Community College Articulation and Curricular Structure

The state-mandated articulation program is a major issue for all Florida engineering schools. Most institutions report that few community colleges teach the sophomore mathematics courses that form the base of engineering curricula to the same standards as the engineering colleges. As a result, community college transfers, even with the Associate of Arts degree, too frequently arrive at upper-level institutions with missing courses or with inadequate preparation in key courses such as mathematics. Furthermore, problems arise from poor advising in the community colleges and the fact that only a few community colleges teach sophomore year engineering subjects such as statics, dynamics, or thermodynamics. As a result, the average transfer engineering student graduates with significantly more than the minimum required credits because many of the courses taken at the community colleges are not needed for the engineering degree. The UCF campus report describes innovative steps at that institution to ease the transition for community college transfers into engineering study; these merit consideration at other SUS engineering colleges.

In the campus reports, different institutions give different evaluations of the adequacy of preparation of community college transfer students for engineering study. Some engineering schools report that the level of community college mathematics and science instruction is below that at the senior institutions. Others report that these levels are quite adequate and that the smaller classes and individual attention students receive at the community colleges actually provide better preparation than that of their native students. A possible explanation for this discrepancy could be variations among the community colleges themselves in instructional levels and academic policies.

It is clear that strict interpretation of community college articulation regulations hinders the opportunity for educational innovation in the freshman and sophomore years in engineering at the SUS engineering colleges. This is an arena of significant national activity with the offering of freshman design courses, the introduction of design modules into the sophomore engineering science courses, etc. The NSF Engineering Education Coalitions, as noted above, are driving forces for this change, which is aimed at: (1) producing graduates who are better prepared to meet the needs of today's engineering practice and (2) improving retention through enhanced freshman/sophomore motivation and insight into real engineering problems. This is difficult to achieve in an environment where the faculty do not take "ownership" of their students until the junior year. The need to provide articulation to students from the community colleges should not result in a less than optimum educational experience for native students at the senior institutions.

Space and Facility Needs

The campus reports reveal significant variations in the adequacy of space and facilities among the SUS engineering schools. At some institutions, new or planned facilities appear to be meeting instructional and research needs, while at others serious shortages are evident. The campus reports contain specific recommendations regarding this issue, which deserves the urgent attention of the system administration and Board of Regents.

Equipment Maintenance and Modernization: Laboratory/Computer Fees

ABET accreditation criteria require that each accredited engineering program have a functioning plan for the continued replacement, modernization, maintenance, and upgrade of laboratory equipment and facilities[4]. The specification of a "functioning" plan implies the existence of an adequate and identifiable source of funds for these purposes. At most SUS institutions, the budget reductions of recent years have deprived the engineering colleges of such funds. Furthermore, modern computational facilities are essential for a strong engineering program, and the present inventory of hardware and software at several SUS institutions appears inadequate to meet the needs of a quality engineering program.

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[4] *Criteria for Accrediting Programs in Engineering in the United States*, p. **, Accreditation Board for Engineering and Technology, Inc., Baltimore, MD, 1994.

In view of these considerations, it is worth noting that well over half of all colleges of engineering nationally charge additional fees to engineering students to cover the added expense of engineering education, especially laboratories and computers. These fees range up to $500 per academic year. Current laboratory fees at all SUS institutions are woefully inadequate for this purpose. Given the current inability of the State to provide adequate support for engineering laboratory and computer facilities, it may be necessary to levy additional fees on engineering students to maintain viable and accredited undergraduate programs.

Florida Engineering Education Delivery System (FEEDS)

The Florida Engineering Education Delivery System (FEEDS) offers engineering education, primarily at the graduate level, to engineers throughout the state at or near their place of work. FEEDS courses originating at an SUS engineering college are delivered via videotape and/or digital telecommunications links from the originating campus to various sites across the state. This program has served both its clientele and the institutions well. Significant numbers of practicing engineers earn master's degrees each year through FEEDS, making it a premier example of support for Florida industry by the SUS engineering colleges.

Special funding is provided to support institutional participation in the FEEDS program. However, all participating colleges report that the direct cost of this program (not counting faculty salaries and fringe benefits) significantly exceeds the state-provided budget. As the FEEDs program directors investigate alternative instructional methods for both undergraduate and graduate programs, a reallocation of costs may be necessary. This issue was identified at the time of the 1988 Engineering Education Program Review and merits continued attention.

Fundamentals of Engineering (FE) Examination

Data provided by the SUS staff on the results of the Fundamentals of Engineering Examination for SUS engineering seniors in the latest year available, 1993-94, are tabulated below. This national examination is administered in each state by the board authorized to license professional engineers and is the first step toward such licensure. Students in ABET-accredited engineering programs are eligible to attempt the examination during their senior year.

Institution	Number Taking Exam	Number Passing Exam	Per Cent Passing Exam
FAMU/FSU	215	108	50.2
FAU	59	40	67.8
FIU	114	56	49.1
UF	316	257	81.3
UCF	323	205	63.5
UNF	8	6	75.0
USF	245	147	60.0

UWF(UF program)	2	2	100.0
SUS TOTAL	1282	821	64.0

The passing rates were below the national average of 70 per cent for five of the SUS institutions for the year reported. However, three caveats are offered regarding interpretation of these data.

1. The small number of students attempting the examination at some institutions may not yield a statistically valid sample.
2. The examination is in no sense an "exit examination" for engineering. It primarily covers material from the freshman and sophomore years in the areas of mathematics, physics, chemistry, and certain engineering sciences of particular importance in mechanical and, to a lesser degree, civil engineering. This material is not reinforced as strongly in the upper-level courses in other disciplines and places students outside of mechanical and civil engineering at somewhat of a disadvantage.
3. As noted in the campus reports, some SUS engineering programs require that students attempt the examination as a condition for graduation. Since many engineering students plan to work in positions that do not require licensure, they may not be strongly motivated to prepare and do well on the examination, especially given the intense pressure of their other senior engineering studies.

Hence, conclusions should not be drawn from these data without considering the effects of sample size, the disciplines of students attempting the examination, and whether or not attempting the examination is a condition for graduation.

Responses to Previous (Statewide) Program Review Recommendations

Twelve recommendations dealing with system-wide engineering education issues were offered at the time of the most recent (1988) SUS Engineering Education Program Review. These are listed below along with the actions taken in response to each recommendation.

1. No new colleges of engineering should be considered until the present six engineering colleges are sufficiently funded at a level that will make high quality engineering education possible.

   Response: No new engineering colleges have been established since 1988, but a free-standing baccalaureate Electrical Engineering program has been initiated at UNF and is now in operation. The program began as an off-campus extension of the UF Electrical Engineering program. A similar program is now in operation at the University of West Florida (UWF), also as an extension of the UF program. This program is expected to become free-standing at UWF within a few years. At the same time, all SUS engineering programs continue to experience varying degrees of financial stress.

2. New undergraduate degree programs should not be considered for an institution until the existing degree programs at that institution are adequately funded and the need for a

new program is clearly documented. Masters degree programs should ordinarily be initiated only after the corresponding undergraduate degree has become assured of accreditation. New doctoral programs should not be considered until the corresponding masters program is relatively large and the faculty have already demonstrated research excellence and attracted the research sponsorship needed to sustain a doctoral program.

Response: As noted above, all SUS engineering colleges continue to experience some degree of financial stress. However, new undergraduate and graduate engineering degree programs established have been justified in terms of need and are supported by capable faculties. The few examples where graduate programs have been established without a corresponding undergraduate program have been justified by special considerations for the discipline in question. The proposed simultaneous establishment of masters and doctoral programs in Optical Science and Engineering at UCF appears justified by the unusually strong faculty and research strength already developed in this area and by significant demand from local industry.

3. The State and its engineering colleges should aggressively promote engineering education among the women and minority pre-college student population; funding should be provided for innovative programs that address this problem.

Response: All SUS engineering colleges are engaged in active programs to increase recruitment, retention, and progression to graduation of women and underrepresented minorities in engineering. These initiatives are discussed in the campus reports. Support for these includes federal, state, private, and institutional funds.

4. Funds should be provided over the next three years to address this (faculty salary compression) problem and adjustments made to bring faculty salaries to a level commensurate to the capabilities of the individual professors.

   Response: Low faculty salaries continue to plague all SUS engineering programs. The salary compression problem appears as least as severe as at the time of the 1988 review.

5. Before additional faculty are budgeted, the institution, the SUS office, and legislative committees should make sure that sufficient support staff are also budgeted.

   Response: As noted in the campus reports, adequacy of support staff varies but does not appear to be a severe problem for most SUS engineering programs.

6. Special OCO funding should be continued for the purchase of engineering laboratory equipment, and funding should be provided for the proper maintenance of that equipment.

   Response: Limited equipment funds have been provided at some SUS engineering schools, but no special funds have been allocated for equipment maintenance.

7. The SUS should review the current space allocation formula to insure that adequate credit is given toward the space needs of the research function.

   Response: A shortage of research space continues to be a severe problem at some, but not all, SUS institutions.

8. A study should be conducted determining, on an institution by institution basis, the actual and total costs associated with the FEEDS program and the total income derived from state allocations and the FTE-generated funds. The state should ensure that adequate funds are available for this program, because of its great value to the economic future of the state.

   Response: As noted above and in the campus reports, the direct costs of participation in the FEEDS program continue to exceed the revenues designated for this purpose.

9. The budget appropriations should clearly designate that those funds allocated for FEEDS be spent for that purpose.

   Response: None of the campus reports suggest that funds allocated for FEEDS are being diverted to other purposes.

10. The FEEDS Policy Committee should develop a system that would present the best courses possible, regardless of the offering college, by cross-listing some courses across all the colleges.

    Response: Graduate engineering courses do not appear to be cross-listed among the different campuses.

11. The FEEDS Policy Committee should examine the tape-erasing practice with regard to quality, efficiency, and the flexibility that subsequent offerings would provide to students.

    Response: Tape erasing practices do not appear to have changed since the 1988 review.

12. The FEEDS Policy Committee should study the problem of the extra effort required to present a FEEDS course, and recommend to the Board of Regents a system that would include incentives to the college offering the course and the professor teaching the course. These might include re-allocation of FTE's or state appropriations based on a combination of fixed and variable costs.

    Response: The allocation practices for FEEDS funds do not appear to have changed since the 1988 review.

Conclusions and Recommendations - Statewide

The consultant team is pleased to report that the engineering programs offered at SUS institutions are, overall, of high quality and serve well the needs of Florida and its citizens. However, a shortage of financial resources combined, in some instances, with excessive growth challenge the ability of all SUS engineering programs to maintain quality in the coming years. In several instances noted in the campus reports continued professional accreditation of individual programs may be in jeopardy.

Specific recommendations to address statewide concerns are offered below; those that address issues affecting the individual campuses appear in the campus reports.

1. The consultants recommend that all SUS engineering schools take vigorous action to implement the educational reforms and culture changes being advocated by the national engineering education community as outlined, for example, in the report recently issued by the American Society for Engineering Education (ASEE) Deans Council.[5] These reforms include the introduction of freshman engineering design experiences and the integration of mathematics, basic science, and engineering science instruction throughout the curriculum. Hence, they should include: (1) allowance for some difference in lower division education of transfer and native engineering students, and (2) active partnerships with at least the major feeder community colleges so that transfer students from these colleges will not receive educational experiences of inferior quality.
2. The consultants recommend that SUS engineering deans and others responsible for counseling prospective engineering students and planning enrollment capacity continue to monitor closely local and national engineering job placement activity.

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[5] See, for example, the report "Engineering Education for a Changing World" prepared as a joint study project of the Engineering Deans Council and Corporate Roundtable of the American Society for Engineering Education (ASEE), October 1994; Available from ASEE, 1818 N Street, N.W., Suite 600, Washington, DC 20036.

3. The consultants recommend that all SUS engineering schools continue and intensify their efforts to recruit and retain to graduation members of underrepresented groups at all degree levels. These efforts should be explicitly recognized in SUS funding decisions.

4. The consultants recommend that additional academic and personal support be provided for African American undergraduate engineering students to improve their rates of retention and progression to graduation. These efforts should be explicitly recognized in SUS funding decisions.

5. The consultants recommend that requirements for admission to upper division engineering studies based on a minimum overall grade point average (2.0/4.0 maximum) and minimum grades (2.5/4.0) in required courses in calculus, chemistry, and physics not be used as a basis for designating an engineering program as "limited access" unless they are coupled with a limit on the number of students to be admitted.

6. The consultants recommend approval of exceptions to the 128 semester credit hour maximum recommended in the State's *Accountability Measure 12* for engineering programs impacted by special accreditation requirements, needs of an important clientele, and/or non-technical general education requirements above those normally found in accredited engineering programs in the United States (typically 16-18 hours).

7. The consultants recommend that the innovative steps at UCF to ease the transition for community college transfers into

engineering study be considered as models by other SUS engineering colleges.

8. The consultants recommend that each engineering program have a functioning plan for the continued replacement, modernization, maintenance, and support of laboratory equipment and facilities, as required in the ABET accreditation criteria[6]. The specification of a "functioning" plan implies the existence of an adequate and identifiable source of funds for these purposes.

9. The consultants recommend that the SUS consider establishing special fees for engineering students to support the continued replacement, modernization, and maintenance of laboratory and computer facilities.

10. The consultants recommend that conclusions regarding the quality of engineering programs not be drawn from the passing rates for the Fundamentals of Engineering Examination without considering the effects of sample size, the disciplines of students attempting the examination, and whether attempting the examination is a condition for graduation. Notwithstanding these considerations, offering a free intensive review course for students planning to take the examination may help increase the pass rates.

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[6] *Criteria for Accrediting Programs in Engineering in the United States* (Effective for Evaluations During the 1995-96 Accreditation Cycle), p. 9, Accreditation Board for Engineering and Technology, Inc., 111 Market Place, Suite 1050, Baltimore, MD 21202, 1994.

Two recommendations of the 1988 Engineering Education Program Review deal with matters of continuing concern and hence are restated here as the final two statewide recommendations of the consultants.

11. The consultants recommend that no new colleges of engineering be considered until the present engineering colleges and department are sufficiently funded at a level that will make high quality engineering education possible.

12. The consultants recommend that a study be conducted determining, on an institution by institution basis, the actual and total costs associated with the FEEDS program and the total income derived from state allocations and the FTE-generated funds. The state should ensure that adequate funds are available for this program, because of its great value to the economic future of the state.

CAMPUS REPORTS

University of Florida

George E. Dieter

The College of Engineering at the University of Florida (UF) is a broad, comprehensive unit with 11 departments and 17 programs. It has the mission of providing high quality undergraduate and graduate engineering education for Florida students and of conducting a nationally recognized research program. In addition, the College takes seriously its responsibilities in continuing education for working engineers and in providing outreach to enhance the economic competitiveness of the industry of the state of Florida. As indices of excellence, the College is included in the *US News & World Reports* ranking of the top 25 graduate programs in engineering, has the 17th largest externally funded research program, and ranks 15th nationally in production of doctoral engineering degrees, and 14th in baccalaureate engineering degrees (1992).

Educational Programs

The academic programs are up-to-date and, in several instances, appear to have been developed with the special needs of the engineering opportunities in Florida in mind. All undergraduate programs are accredited by the Engineering Accreditation Commission (EAC) of the Accreditation Board for Engineering and Technology (ABET). Every program has reduced the number of credits required for the BS in engineering. By next year the following programs will be at or below the level of 128 credit hours specified in *Accountability Measure 12*: Computer Engineering; Electrical Engineering; Environmental Engineering; Nuclear Engineering; and Surveying and Mapping. Much thought has gone into this process. Three programs that still require more than 128 credits have strong rationales for doing so.

1. The *Chemical Engineering* Program must require 16 credits of advanced chemistry to meet ABET/AIChE accreditation requirements. The program actually requires fewer chemical engineering credits than most accredited programs.
2. There is a strong desire to maintain the reputation of the *Civil Engineering* Program as the premier Civil Engineering program in the state in the view of employers, chiefly small engineering firms. This requires a broad preparation in many Civil Engineering sub-specialties, which increases the credit hours required for the degree. Letters from graduates and employers strongly defended this approach.
3. The strong *Materials Science and Engineering* Program faculty permits the preparation of students in a broad spectrum of materials specialties. This greatly aids in employment opportunities for the graduates. The Department has an excellent reputation among employers, who represent top national and international firms.

The quality of these programs should not be jeopardized by slavish adherence to a 128 credit maximum. At the same time, avenues should be explored to reduce the time required by students to obtain the BS degree.

Transfers from community colleges apparently have no difficulty in entering the College of Engineering. About 45 per cent of the undergraduate students in the College began their studies at community colleges. However, problems arise from poor advising in the community colleges and the fact that only a few community colleges teach sophomore year engineering subjects such as statics, dynamics, or thermodynamics. As a result, the average engineering student transferring from a community college graduates with about 160 credits because many of the courses taken at the community colleges are not needed for the engineering degree. Only about six or eight community colleges are significant feeders to the UF College of Engineering.

It is clear that strict interpretation of community college articulation regulations hinders the opportunity for educational innovation in the freshman and sophomore years in engineering at UF. This is an arena of significant national activity with the offering of freshman design courses, the introduction of design modules into the sophomore engineering science courses, etc. The National Science Foundation (NSF) Engineering Education Coalitions such as ECSEL, Synthesis, and SUCCEED are driving forces for this change, which is aimed at: (1) producing graduates who are better prepared to meet the needs of today's engineering practice and (2) improving retention through enhanced freshman/sophomore motivation and insight into real engineering problems. This is difficult to achieve in an environment where the faculty do not take "ownership" of their students until the junior year. The need to provide articulation to students from the community colleges should not result in a less than optimum educational experience for native students at Gainesville.

Due to limitations of faculty, facilities, and equipment several programs in the College of Engineering have been designated "Limited Access Programs." With the implementation of the Monitoring Academic Progress Program (MAPP) in the Fall of 1993, the College of Engineering established uniform undergraduate admissions criteria for all of its programs. Beginning with the 1994-95 academic year, applicants for all engineering programs must have an overall grade point average of at least 2.0, and in addition, a 2.5 GPA is required in pre-engineering technical courses (mathematics, physics, and chemistry). Experience has shown that performance at least at this level is necessary for success in engineering courses. With the initiation of these uniform admission requirements, the College of Engineering removed the designation of limited access from all undergraduate engineering programs.

Students

Admission standards are appropriate to a quality undergraduate engineering program at a research-oriented state university. The average SAT scores of the engineering freshmen exceed those of 90 per cent of the students in the state and the nation.

The students interviewed were bright and energetic and expressed a high regard for the engineering programs at UF. The undergraduate programs offered at the College of Engineering are as broad as would be found almost anywhere in the nation. Its graduate programs are among the strongest in the nation and certainly by far the strongest in the state.

The only data offered on passing rates for national licensure examinations are results from the Fundamentals of Engineering Examination, which is the first step required for registration as a Professional Engineer. The passing rate at the University of Florida is somewhat higher than at other Florida universities and is at the national average overall.

Most departments have conducted extensive surveys of graduates and employers. The University Consultant read about 40 such reports from two departments. Overall they were very laudatory. From the data received, the accreditation record, and the general reputation of the College, it must be concluded that students are receiving an excellent engineering education.

Pre-engineering students are tracked by the Monitoring Advisory Progress Program (MAPP). Letters are sent to the students after they have completed 30, 45, and 60 credits, advising them of their progress toward becoming upper division students in the College of Engineering. The engineering department chairs interviewed did not feel this is working particularly well. The College of Engineering has created an advising center with one experienced counselor to handle the more than 1000 students who have declared an engineering major. This is an unrealistic load for a single person. Students are cleared for graduation based on the SAS program. The Assistant Dean of the College has monthly meetings with the undergraduate coordinators in the departments. They provide special tracking and counseling for students whose GPA is below 2.3.

A common complaint heard from the chairs, the faculty, and the students is that advising given to lower division students, all of whom are officially housed in the College of Liberal Arts and Sciences, is not well done. Students are often not placed in the courses they need for efficient progression to the engineering degree. The feeling was expressed that many students with the ability to complete engineering programs are "steered out" of engineering at this stage. Engineering faculty felt that there is better advising communication with the community colleges than with the liberal arts and sciences faculty at UF. Also, there is great concern that lower division students at UF often are not able to get the science and liberal study courses that they need for adequate progression to the engineering degree.

A new experiment, due to start in Fall 1995, guarantees access to necessary courses and the promise of graduating in four to four and a half years to students who register in a "block" for at least 15 credits (plus 8 credits during summer school). This applies to freshmen at UF and transfers from Santa Fe and Broward Community Colleges. Many faculty members are skeptical that large numbers of students will opt for this program.

The number of women and underrepresented minorities is about average for the size and nature of the college. Enrollment of higher proportions of such students appears to be inhibited by: (1) an inadequate number of scholarships available to minorities in engineering, and (2) the lower-upper division structure. An associate director of development has been hired to mount a campaign aimed at providing minority scholarships through private giving. This will take time to have a real impact. With regard to the second point, faculty feel that a number of minority and women students are lost to engineering because of the inadequate advising they receive during their first two years.

The arrangement by which entering students are enrolled in Liberal Arts and Sciences for the first 60 credits distorts the entire undergraduate education of engineering students. Such a formal lower division-upper division structure exists at only a few engineering schools. Because the engineering faculty do not "take ownership" of their freshmen and sophomore students, nor interact with them in significant numbers, it has prevented meaningful experimentation with freshman-sophomore engineering courses. As noted above, the structure also appears to have a negative affect on the enrollment of women and minorities in engineering. A significant result is that engineering students complete essentially all of their non-technical requirements in their first two years and take only technical courses in their last two or three years. This is not a good pedagogical situation. It also leads to inefficient utilization of resources by delaying the graduation of most native engineering students by at least one semester, and it prevents the creation of a modern, integrated four-year engineering curriculum. The University Consultant was impressed and surprised with the degree to which department chairs and faculty were interested in becoming engaged in educating their students at the freshman-sophomore level and hopes that the curricular structure in the University can be changed to allow this to occur.

Faculty

Overall, the University of Florida engineering faculty is outstanding, with many individuals of national and international distinction. Good progress has been made in recent years in adding minority and women faculty. This is all the more commendable given the serious problem with providing competitive engineering faculty salaries.

The department chairs as a group were judged to be outstanding. They appeared to be knowledgeable about issues in engineering education nationally and on the campus. Most are distinguished engineers. A good spirit of cooperation between departments and with the dean's office was evident. The Dean is a nationally-recognized leader in engineering education and provides outstanding leadership to the College and on the campus. He has an effective and dedicated staff and the entire operation of the College gives the impression of a well oiled machine.

No documentation was presented concerning quality of teaching or quality of scholarship and research. However, the students were highly supportive of the program and voiced no concerns about teaching quality. The faculty expressed a surprising and commendable concern for good teaching. Their funded research support is strong and is increasing. The overall reputation of the College of Engineering and its programs is high.

The College is currently searching for several Eminent Scholar positions. The Dean of Engineering expressed concern that the annual funds available from such positions were not, themselves, sufficient to attract eminent engineering researchers and, when coupled with the constraints imposed by the System, the entire package was not especially attractive.

The College of Engineering is heavily engaged in external activities. Much of its research is oriented toward the needs of Florida business and industry. The College is deeply involved in the education of working engineers in Florida through FEEDS, the National Technological University, the Center for Advanced Studies in Engineering at West Palm Beach, and off-campus offerings at Eglin AFB, where its commitment has recently increased.

A major problem area is low faculty salaries. For 1993-94 the engineering salaries were the lowest in all three ranks when compared against a benchmarking group of 12 comparable engineering schools. While the special Teaching Improvement Program (TIP) funds for outstanding teaching are very welcome and send an important signal to the faculty about the importance of teaching, these funds do not address the basic problem of relatively low salaries for a very distinguished faculty. It is indeed remarkable that so few faculty have left, given the excellent job mobility that a majority enjoy. That they remain at UF is a tribute to the overall excellence of the engineering program, the pleasant environment, and the dedicated leadership. However, if the problem continues for an extended period, some of the best faculty will almost surely leave for higher salaries elsewhere. Short-term relief might be provided if some of the budget flexibility granted by the legislature to the Board of Regents could be used creatively to address this problem. However, both the department chairs and the dean's office report that this budget autonomy has so far not affected their financial operations.

Facilities and Resources

Major progress has been made recently in providing laboratory and office space for the rapidly growing research activities. These include a new engineering building, chiefly for Electrical, Environmental, and Aerospace Engineering (131,000 sq.ft.); renovation and addition of two floors to Rhines Hall for Materials Science and Engineering (35,000 sq.ft.); a building to house the recently established NSF Engineering Research Center in Particle Science and Technology (25,500 sq.ft.); and a 44,700 sq. ft. building at Eglin AFB. The existing engineering buildings are well used and reasonably well maintained.

The Science and Technology Library suffers from the inflation in materials costs which bedevil all research universities. No complaints were heard about the library from faculty or department chairs. The library seemed to be coping with its problems effectively and to be forward thinking in the use of electronic media.

A shortage of funds for refurbishing teaching and research laboratories is a perennial problem. A concern is that these are provided as one-time funding, often with a short lead time for planning and decisions. Here is an area where greater fiscal autonomy could be used to advantage if a way could be found to allow year-to-year carryover.

Responses to Previous Program Review Recommendations

The most recent SUS Engineering Education Program Review (1988) contained three recommendations for the UF College of Engineering. These are listed below, along with the actions taken in response to each recommendation.

1. The State should fund a new engineering building.

   Response: As discussed above, a major building is in the advanced planning stage, and additional buildings have resulted from college initiatives -- the Particle Technology Building came as a result of winning a highly competitive NSF Engineering Research Center award, and the renovation to Rhines Hall from a NSF facilities renovation grant.

2. Funding should be continued for laboratory equipment, recruitment of young scholars, and exceptional young faculty. *Response:* Although funding is never all that is needed, state OCO funds and creative use of institutional funds have allowed the College to employ about 80 new faculty in the past five years. The College has provided competitive entry salaries but this has further acerbated the salary compression for senior faculty. The College has been particularly effective in recruiting women and minority faculty.

3. Added faculty positions should be provided to support the center at Eglin Air Force Base. *Response:* With the expansion of the mission of the Eglin Center to include the graduate engineering education needs of Northwest Florida, six full-time faculty have been provided and searches are underway to fill two additional positions. A new facility at Eglin expected to be available in Spring 1995 will accommodate a resident faculty of 15.

Strengths and Needs

The following are judged to be strengths of the UF College of Engineering.

1. With an outstanding faculty, strong leadership, good students, and adequate facilities, the College of Engineering has all of the ingredients to continue to grow in national reputation and in service to the citizens of Florida.

2. The high reputation of the bachelor's graduates among employers in today's highly competitive engineering job market results from broad-based curricula, some of which exceed the SUS guideline of 128 semester hours for valid reasons.

Major unmet needs of the UF College of Engineering include the following.

1. Faculty salaries need to be increased to at least the average of peer institutions. Until this is done there will be a threat, growing year by year, of losing the major gains that have been made in building an outstanding faculty.
2. The artificial division between lower division and upper division studies inhibits the development of modern, innovative engineering curricula and extends the time required for many engineering students to complete their degree requirements. Under the present structure, the faculty cannot be expected to be fully engaged in the education of engineers during the crucial first two years. The national trend in engineering education is to develop the entire four years as an integrated educational experience rather than a collection of courses that often seem unrelated to students. Much successful innovation is occurring in freshman/sophomore courses which enhance understanding and motivation and, therefore, increase retention and reduce the time for the degree. These curricular improvements cannot be fully

realized at UF until the artificial lower division-upper division structure is removed.

Recommendations

The consultants offer the following recommendations.

1. The consultants recommend that the Dean of Engineering work with all constituencies of the College, including the Board of Visitors, alumni, and Florida industry, to enlist their support with the legislature for improving faculty salaries.
2. The consultants recommend that the University administration delegate financial flexibility to the College of Engineering to assist it in addressing the faculty salary problem.
3. The consultants recommend that freshmen engineering students at the University of Florida be admitted directly into the College of Engineering if they meet appropriate admission standards. The College would be responsible for their advising and well being, develop appropriate courses, and take measures to increase retention and reduce time to graduation. All curricular innovations would be made available to community colleges that send transfer students to the College of Engineering. Lack of these courses at a community college should not hinder the progress of engineering students once they transfer to Gainesville.
4. The consultants recommend that significant funding be made regularly available for updating instructional laboratories in the College of Engineering. State funding agencies

should be cognizant of these needs and look for ways that additional financial flexibility can be achieved so these funds can be used in the most productive ways.

FAMU/FSU College of Engineering

Robert G. Hering

In 1982, the Board of Regents of the State University System of Florida established a joint Florida A&M University/Florida State University (FAMU/FSU) College of Engineering, the only engineering college in the nation that is shared between two universities. The mission of the College is:

> "...to educate engineers of excellence as judged by the highest standards in the field and by recognized national peers at both the undergraduate and graduate levels; to attract and produce greater number of blacks, women, and other minorities for professional engineering practice, engineering teaching, and engineering research; and to attain national and international recognition of the college through the professional achievements of the faculty, staff, students, and graduates.

The emphasis on producing ethnic minority engineers and women engineers at both the undergraduate and graduate levels is a distinguishing characteristic of the College.

Educational Programs

Degree programs are offered in five departments: chemical engineering, civil engineering, electrical engineering, industrial engineering, and mechanical engineering. These are the fields most often selected by students as well as desired by industrial employers and are judged appropriate for the College. Educational opportunities spanning the three academic levels (BS, MS, and PhD) are offered in all departments except civil engineering and industrial engineering, which do not have doctoral programs. The undergraduate degree is conferred by the university in which the student is registered while completing upper division studies (FAMU or FSU). The graduate degree is conferred by the university in which the student has completed degree requirements.

The highest priority for engineering program development at FAMU/FSU is the establishment of doctoral programs in civil engineering and industrial engineering. These additions are judged appropriate *if* adequate resources, including space, can be provided. The establishment of doctoral programs in these departments can enrich the quality of education for undergraduates through access to modern laboratory facilities and computers, provide funds for graduate student stipends, offer educational opportunities at the PhD level which are not available at the other HBCU's, and allow the College to offer the full range of educational opportunities in each of its departments. The rapidly growing external research funding being secured by the faculty in each department is testimony to the currency and quality of the research already underway. The proposed civil engineering doctoral program would emphasize infrastructure engineering and sustainable technology, both of which are emerging disciplines of great national importance. The industrial engineering doctoral program would build on the strength of its manufacturing systems capability with an emphasis on minimizing undesirable environmental effects from manufacturing processes. This also is an emerging field with significant opportunities for early leadership. Neither PhD program is currently on the SUS 1993-98 Master Plan List of Academic Degree Programs.

The FAMU/FSU undergraduate engineering programs were reviewed by the Engineering Accreditation Commission (EAC) of the Accreditation Board for Engineering and Technology (ABET) during the 1991-92 academic year. In 1992, the College was notified by ABET that each of its undergraduate programs had been reaccredited for the maximum period of six years. The report to the institution stated, however, that "The impact of frozen budgets at public institutions in Florida will eventually have a serious detrimental effect on the undergraduate programs at Florida A&M University and Florida State University. Funds for faculty development, support staff, equipment, and library acquisitions, are necessary for satisfying minimum criteria for accreditable programs." With regard to the physical facilities, the ABET report stated that "Even though the engineering building is relatively new, increased undergraduate enrollment, funded research and proposed new graduate programs have already led to serious space problems." The next ABET review is scheduled for the 1997-98 academic year.

The current SUS review, which encompasses both undergraduate and graduate education, confirmed that all programs had appropriate depth, breadth, and currency and that the curricula were properly sequenced.

The Florida Engineering Education Delivery System (FEEDS) offers engineering education, primarily at the graduate level, to engineers throughout the state at or near their place of work. FEEDS courses originating at FAMU/FSU are delivered primarily via a digital telecommunications link between the Tallahassee campus and the FEEDS service area in Panama City. This program has served both its clientele and the institution quite well. For example, during the 1993-94 academic year, 16 students graduated and 18 FAMU/FSU courses were delivered on FEEDS.

Appropriate policies, procedures, and practices are in place for community college articulation. The College has an Advisory Board whose membership consists of eminent persons from academia, industry, and government. This Board is used in an appropriate manner to assist the College in achieving its goals. None of the programs reviewed are Limited Access programs, although serious consideration is being given to requesting such a designation because of the limited human resources and physical facilities currently available.

Accountability Measure 12 of the State of Florida specifies 120-128 semester credit hours as the desired hour range for an undergraduate degree. All FAMU/FSU undergraduate engineering programs exceed the desired maximum of 128 semester hours. The larger number of credits does not result from excessive engineering, mathematics, or science credits, which are quite comparable to those of other accredited engineering programs in the United States. Both FAMU and FSU, however, have non-technical general education requirements greater than those typical of US engineering programs. Taken together, the necessary engineering coursework and the required general education coursework require more than 128 semester credit hours to complete.

Students

Engineering students are admitted directly to each university and thus must meet the admission requirements of the institution in which they choose to enroll. The requirements of the two institutions differ somewhat. This practice of direct admission to the universities does not provide any enrollment management opportunities for the College, which has experienced major enrollment growth over its short history. In 1982, 35 undergraduates were admitted in the first class. In the fall semester of 1993, headcount enrollment had grown to 1,908 undergraduate and 157 graduate students for a total enrollment of 2,065.

FAMU/FSU is in fourth place in undergraduate engineering student headcount among the eight SUS universities offering engineering[7]. FAMU/FSU also is the fourth largest engineering program in the SUS based on total (undergraduate plus graduate) enrollment. However, graduate enrollment is the lowest among SUS engineering colleges offering graduate programs.

It is significant to note that the FAMU/FSU Engineering College leads all SUS engineering colleges in the number of African American undergraduate students enrolled (930, or 58.4 per cent of the statewide total) and second in the number of women (478, or 23.1 per cent of the statewide total). However, performance at the graduate level is less impressive; only 13 African American graduate students (13.7 per cent of the statewide total) and only 20 female graduate students (4.4 per cent of the statewide total). The fall 1993 undergraduate student enrollment was divided reasonably well between the two universities, with 58.5 per cent enrolled at FSU and 41.5 per cent enrolled at FAMU. However, graduate enrollment was predominantly at FSU (87.9 per cent). The composition by race of the undergraduates was 48.7 per cent African American, 41.1 per cent Caucasian, 3.4 per cent Hispanic American, and 6.5 per cent other groups. Women made up 25.1 per cent of the undergraduate engineering enrollment. The College is clearly meeting its goals in enrolling African American minority students and women in its undergraduate programs and is to be commended for this significant achievement. The current mix in undergraduate enrollment with respect to race and gender is rare if not unique in undergraduate engineering education in our nation.

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[7] Enrollment figures are taken from the State University System 1993 Fall Student Course Data File for Engineering.

The 1992-93 FAMU/FSU baccalaureate engineering graduates were 23.5 per cent African Americans and 25 per cent women; each of these values are extraordinarily high relative to national norms and the highest of any engineering college in the SUS system. More importantly, the number of African Americans who earned the BS degree at the College (45) was eighth in the nation and more than twice the number (22) graduating at any other engineering college in the SUS system. The 50 BS degrees granted to women ranked second in the SUS. The College is making a major contribution to bringing women and minorities into the engineering profession. Of concern, however, is the observation that the proportion of African Americans among BS degree recipients is only about half that in the undergraduate engineering enrollment (23.5 per cent vs. 48.7 per cent). By contrast, the proportions of women among the BS engineering graduates and in the undergraduate engineering student body (25.0 per cent vs. 25.1 per cent) are about equal. This suggests the need for additional academic support measures to improve the rate of progression to graduation of the African American students.

The College has been highly productive in terms of degrees awarded. Since the conferring of the first BS degrees in 1985, the College has granted over 1,200 BS, 250 MS, and 6 PhD degrees. During the 1992-1993 academic year and summer session, 218 BS degrees were awarded, placing the College fourth in the SUS. Faculty productivity in terms of BS degrees awarded per full-time equivalent faculty member per year is 4.3 for the College of Engineering, about 1.7 times the national average of 2.6, the highest value in the SUS, and 43 per cent larger than the average of 3.0 for the other five large SUS engineering colleges.

The distribution of majors among the engineering programs is judged to be appropriate, and there is no program at any academic level which has low enrollment.

In the past the College has required that all bachelor's degree candidates take the Fundamentals of Engineering examination, which is the first step in seeking registration as a professional engineer. Nationally, only a limited number of engineering colleges have such a requirement. According to data provided by the SUS staff for the 1993-94 administrations of this examination, the passing rate for FAMU/FSU students was 50.2 per cent, somewhat below the average of 64.0 per cent for students at all the SUS engineering schools. The national passing rate was 71 per cent for 1993-94. The lower passing rate may perhaps result from the attitude of the FAMU/FSU students taking the examination. Since passing the examination is not a graduation requirement, many students may not invest significant effort in preparation, and some may simply sign in and leave without attempting the examination. A similar phenomenon has been observed at other schools with this requirement, where passing rates tend to be significantly lower than those for students who take the examination voluntarily and are, for the most part, dedicated to scoring well. The College has recently changed its policy to make the requirement of the Fundamentals of Engineering Examination a departmental option. Thus FSU/FAMU students who take the examination in the future will more likely be those in disciplines where professional registration is often required, e.g., civil engineering, and their passing rates may more closely match state and national averages.

The College has an excellent tracking system to monitor students' academic progress, as well as their professional careers after graduation. However, differences in "grade forgiveness" policies between the two universities create academic advising difficulties for the faculty. Data provided by the College suggest that FAMU/FSU baccalaureate engineering graduates are successful in their professional careers and that a significant number have successfully continued their educations at highly regarded engineering graduate programs.

A group of representative employers of FAMU/FSU engineering graduates were interviewed and expressed general satisfaction with those they have employed. FAMU/FSU graduates were reported to be as well educated and prepared for the industrial world of work as the graduates of better-known engineering schools. Existing advising services and retention programs will be substantially expanded and improved with a recently allocated permanent new budget to the College's Minority and Women Enhancement Program. Space and offices have been provided for a variety of engineering student organizations.

Unfortunately, the enormous enrollment growth in the College has not been accompanied with a commensurate increase in human, physical, and financial resources. Faculty resources are wholly inadequate to serve the current enrollment, and the negative effects on the quality of engineering education are becoming evident. This critical issue was brought into sharp focus during interviews with senior students, who were well-motivated, hardworking, and articulate. Early in their careers at FAMU/FSU they had been pleased with their educational experiences in the College. However, this early positive attitude has been severely eroded in recent years as a consequence of a major enrollment increase without new resources for its support. The students reported that classrooms and laboratories are now overcrowded, laboratory equipment needs updating and maintenance, computer resources are obsolete, and faculty availability for student counseling and academic advising has declined severely. They expressed the opinion that the College was being treated as a "step-child" and that the two institutions were not working together cooperatively to improve their situation. They cited as examples the infrequent and irregular shuttle bus service between the College of Engineering and the two main campuses and their inability to obtain student activity funds from either institution in support of the engineering student organizations.

The most telling student criticism was that none of those interviewed - a broadly diverse group with regard to academic level, race, and gender - said that they would now recommend the FAMU/FSU College of Engineering to their family members or friends.

Faculty

The FAMU/FSU engineering faculty interviewed were well qualified, enthusiastic, committed to teaching, supportive of each other, and dedicated to the mission of the College, especially its commitment to the education of women and African American minorities. All engineering faculty members hold an earned doctorate, in most cases from highly regarded engineering colleges. Their dedication to student learning is commendable as evidenced by their efforts to maintain high quality classroom teaching as well as contemporary course materials in both the classroom and the laboratory, in spite of serious obstacles.

Faculty effort is distributed appropriately among teaching, research, and professional service. All engineering courses are taught by engineering faculty. Most faculty members are active in research and publish their work in recognized technical journals or the proceedings of national and international conferences and symposia. Some should be encouraged to publish more of their research in refereed journals. Most faculty members participate in a wide variety of professional service activities within the department, college, and university as well as in national professional organizations. Internal cooperation of faculty within departments, as well as among faculty of different departments, was exceptional. The quality of leadership at the Dean's level and at the departmental level is excellent.

External funding of faculty research is already at an outstanding level ($22 million over the past five years) for the faculty size, and is improving as the faculty expands and matures. These resources are essential to establishing an effective and productive graduate program. Such funds provide graduate student stipends, modern laboratory and computing equipment, and fruitful opportunities for undergraduate research participation.

Exceptional linkages exist between the FAMU/FSU engineering faculty and other faculty at both universities, including those in specialized units such as the Geophysical Fluid Dynamics Institute, Center for Nonlinear and Nonequilibrium Aeroscience, National High Magnetic Field Laboratory, Center for Materials Research and Technology, and Supercomputer Computations Research Institute.

The distribution of faculty by age, rank, gender, and race is appropriate. It is exceedingly important for an engineering college with a major commitment to serving women and minorities to have a significant representation of women and minority role models among the faculty. Faculty recruiting has emphasized the hiring of such persons, and the College has been unusually successful in this endeavor, in view of the small number of engineering doctorates granted to such persons and the fierce national competition for their services. In the 1993-94 academic year, eight African Americans or persons of African descent and six women were added to the FAMU/FSU engineering faculty.

The Eminent Scholar is Professor and Chair of Mechanical Engineering and holds the Don Fuqua Chair. He is nationally and internationally known for his research in fluid mechanics, and he attracts a high level of external funding, as well as high quality faculty and graduate students to work with him in his research programs. He also provides effective and innovative leadership to the Department of Mechanical Engineering. The impact of this scholar's work on the department, college, university, and community is extraordinary.

In spite of exemplary efforts by the faculty, overall faculty resources of the FAMU/FSU College of Engineering are inadequate to ensure a high quality education for all students. The shortfall in faculty resources is manifested in many different ways. Class enrollments are too large to provide adequate in-class and out-of-class attention by the instructor to meet the legitimate needs of the student learners, particularly those less well-prepared. Multiple laboratory sections are required to accommodate student numbers, further increasing faculty workload. Inadequate faculty time is available for supervision of design projects, which form probably the most important component of the undergraduate engineering student's education.

Faculty members in some departments serve as academic advisors to 50-60 undergraduate students, which limits severely the time and attention they can devote to assist students in meeting curricular requirements and to help them select suitable elective courses to accommodate their individual interests.

Little time is available for faculty professional development. Furthermore, the faculty is overburdened by the necessity to deal with two university administrations with different policies, procedures, and practices in regard to faculty, staff, student, and financial matters.

As a result of uncontrolled enrollment growth without commensurate increase in faculty resources, the student to faculty ratio is extraordinarily large when compared to national norms as well as those at other SUS engineering schools. The ratio of undergraduate students to faculty for the 1993-94 academic year was 35:1. This is 2.3 times the national average of 15:1 and almost twice the average of 20:1 for the other five large engineering colleges in the SUS. To provide a student/faculty ratio comparable to the latter would require approximately doubling the current faculty.

Until the current dean joined the College in 1992, there had been no growth in faculty resources in response to enrollment increases. The Dean negotiated an increase of 10 faculty, and 8 more will be added in a newly funded initiative (Minority and Women Enhancement Program) in the College. This will bring the faculty total to about 63 and lower the undergraduate student/faculty ratio to about 30:1, still 50 per cent above that for the other SUS engineering schools.

Interviews with the faculty, department chairs, and Dean revealed a unanimous belief that the College of Engineering should have greater autonomy in managing its resources and in developing and administering student academic policies. Clearly, the most important current issue is enrollment management.

Faculty salaries are low when compared to southeastern engineering school norms as well as those for other SUS engineering colleges. Moreover, budgetary provision for faculty development is judged to be inadequate. Teaching assistant support to the faculty is also inadequate to meet the demands imposed by current enrollments, and teaching assistant stipends are well below those of engineering schools with strong graduate programs.

Facilities and Resources

The permanent College of Engineering facilities consist of a six year old structure which was designed for 1,000 students, a faculty of about 50 persons and a commensurate number of staff. Now it serves over 2,100 students, about the same faculty and staff, and a large number of externally funded research programs. This results in severe shortages of space for faculty offices; teaching assistant desk space; number and size of classrooms, instructional laboratories, and research laboratories. Space that was once entirely dedicated to undergraduate laboratories is now also accommodating research activities, faculty offices, staff offices, and teaching assistant desks. No commons space is available for students, although the College allows students to use the Atrium area for this purpose.

In addition to the severe space shortage, the remoteness of the College of Engineering from the main campuses detracts significantly from the academic quality of life for engineering students. Shuttle service between the College and the main campus is neither convenient nor reliable, and students must schedule a full period in between classes to assure arrival for class on time. Student participation in organizations and campus functions is curtailed because of the distance and time factors. The current remote location severely isolates the College and makes it extremely difficult for students, staff, and faculty to interact with colleagues in main campus activities. Students are handicapped by the current inconvenient access to libraries, non-engineering classes, living and eating facilities, etc. These factors are deterrents for recruiting and retention of students.

The critical space shortage is being addressed temporarily by renting modular units. However, a permanent solution to the space and remoteness problems has been proposed by the Dean. It consists of constructing a new engineering building at a location between, and much closer to, the two universities. This building would serve as the principal facility for engineering education, and the present, more remote facility would be dedicated to research laboratories and technology transfer activities. The Dean's plan eliminates both the space and location problems and deserves the strongest support by both universities.

The College of Engineering has no library, but the engineering building contains a small reading room, stocked with about 3,000 volumes that serve as reference material and are not allowed to circulate. Comprehensive library services to the engineering faculty and students are provided by the main libraries of the two universities. The reference and journal holdings of the main libraries are adequate to serve the needs of students and faculty, but their remoteness from the College reduces the effectiveness of their support for the engineering programs.

Laboratory equipment is insufficient to serve the current enrollment and is becoming outdated. Additional, upgraded

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equipment is badly needed to provide modern laboratory experiences for the undergraduates. Computer resources are also insufficient and outdated; they need to be expanded and modernized. Office expense budgets and support staff are also inadequate for the current enrollment and urgently need to be expanded.

In summary, the College needs a substantial increase in operating budget to fund new faculty and staff positions, support adequate office expenses, update undergraduate laboratory equipment, and modernize instructional computing resources. Only then will a high quality education be restored for a student body twice the size planned for in the current budget.

Responses to Previous Program Review Recommendations

The most recent SUS Engineering Education Program Review (1988) contained four recommendations for the FAMU/FSU College of Engineering. These are listed below, along with the actions taken in response to each recommendation.

1. A management plan should be developed by the two institutions as soon as possible and, when approved by the Chancellor, should be put in place as soon as possible. New program consideration should be delayed until the management plan is in place.

   Response: A management plan entitled *Memorandum of Agreement on Management Plan of the College of Engineering* dated January 5, 1988 was signed by the Presidents of Florida A&M

University and Florida State University. It has been in effect since that date.

2. The search for a dean should be accelerated and be a high priority of both institutions.

   Response: The College has had two deans since Dr. Dantin returned to the faculty in 1987. Dr. Krishnamurty Karamcheti served from 1987 to 1992. Dr. C. J. Chen has served as Dean since the fall of 1992.

3. The Industrial Engineering Program should be delayed until enrollments in existing programs are examined to see if there is continued growth in Fall 1987 enrollments.

   Response: Enrollments continued to grow, and justified the establishment of the Industrial Engineering Program.

4. Stand-alone master's programs should not be initiated in Panama City since a wide range of programs already exists on the FEEDS network. Further strengthening of the on-campus programs should occur before a primary FEEDS center is established at FSU.

   Response: No stand-alone graduate programs have been established at Panama City, and the primary FEEDS network at FAMU/FSU was only established after strengthening of the on-campus graduate programs.

Thus all recommendations of the previous review were followed, although, in view of the inability of the College or the sponsoring institutions to deal effectively with the coordinated management of enrollments and resources, one may question the adequacy of the current Management Plan (Recommendation 1).

Strengths and Needs

The following are judged to be strengths of the FAMU/FSU College of Engineering.

1. The College has accepted as a major goal, the responsibility to contribute substantially to increasing the number of minorities and women in the engineering profession at all degree levels.
2. The undergraduate enrollment in the College currently consists of almost equal numbers of minority and majority students, including about 25 per cent women. This is a unique mix of students by race and gender in an engineering college. The richness of this learning environment, which encompasses both cultural and gender diversity, provides every undergraduate with a unique cultural experience while studying engineering.
3. The engineering faculty not only is committed to quality teaching, research, and professional service, but also is dedicated to the mission of the College in the education of minorities and women. Many faculty members serve as role models for the minority and female students because of the gender and ethnic diversity of the professorate. Testimony to the quality of the faculty is the excellence of their teaching, the publication of their research in leading

journals, and the burgeoning external financial support they are attracting from government and industry.

4. Excellent cooperative relationships exist among faculty within and across departments, and excellent leadership is provided by the department chairs and the Dean.
5. Substantial financial support is available for minority students at both universities.

Major unmet needs of the FAMU/FSU College of Engineering include the following.

1. The current structure by which the two universities govern the College of Engineering creates additional workload for faculty, staff, students, and administration because of the need to interact on a daily basis with both universities in matters related to students and finances. Procedural changes at both universities and more administrative autonomy for the College could go far to alleviate these difficulties.
2. The remote location of the College detracts from the educational experience of students and isolates the faculty from their colleagues. Neither students nor faculty have a sense of belonging to either of the universities, and the academic quality of life suffers accordingly for both.
3. The present engineering building cannot accommodate the current programs. Both a long range plan to meet the needs of the College and immediate actions to relieve the current severe space shortage are urgently needed.

4. The salary budget is inadequate to assure students a high quality engineering education. A faculty of twice the present size is needed to provide a student to faculty ratio comparable to those of the other SUS engineering colleges. Supporting staff and operating funds also need to be increased to levels appropriate for the current enrollment.

Recommendations

The issues of inadequate space and operating funds, uncontrolled enrollment growth, and desire to implement new programs are interlocking and cannot be dealt with individually. Accordingly, the consultants offer the following recommendations.

1. The consultants recommend that the College of Engineering develop a strategic plan, as soon as possible, addressing the character of the College, its enrollment goals and the programs to be offered at all academic levels, the resources (physical, human, and fiscal) needed to ensure a quality education to all of its students, milestones to be achieved with timetables, and other pertinent information. The final plan should be the result of discussions and decisions involving both university administrations and the College Joint Management Council.
2. The consultants recommend that the strategic plan be approved by the Joint Management Council and implemented as quickly as possible. It is essential that the plan's operational commitments (enrollments, new degree programs) **not** be

implemented without the needed resource commitments (faculty, funding, space). It is also essential that the College be given full authority and responsibility to implement the final plan so as to (a) restore the high quality educational experience for all engineering students and (b) assure a positive outcome for the FAMU/FSU engineering programs at the time of the next professional accreditation review.

3. The consultants recommend that both university administrations work together more cooperatively so that the students, faculty, staff, and leadership of the College can continue on a path to academic excellence.

In summary, with the full support of both institutions, the Joint Management Council, the SUS, and the State of Florida, a superb engineering college with unique and important features can develop. The academic excellence of the College of Engineering will enhance the national reputation for excellence of both sponsoring institutions and the State.

University of South Florida

Christian E.G. Przirembel

Educational Programs

The University of South Florida (USF) College of Engineering offers baccalaureate degree programs in Chemical, Civil, Computer, Electrical, Industrial, and Mechanical Engineering, as well as in Computer Science and Information Systems. The six engineering programs are accredited by the Engineering Accreditation Commission (EAC) of the Accreditation Board for Engineering and Technology (ABET). Graduate degrees (MS, PhD) in most of these disciplines are also offered. The next ABET general review is scheduled for the 1995 fall term. Based on both the last two ABET reports to the institution and this review, it appears that the strongest undergraduate programs are Electrical and Industrial Engineering. There are some very serious concerns about the Mechanical Engineering program. In fact, the possibility of a "show cause" recommendation at the next ABET visit was indicated for this program. Deficiencies in design, advising, faculty size and space for offices, laboratories, and classrooms were cited for Mechanical Engineering. The first two areas are being addressed by the program faculty. The deficiencies not under direct faculty control merit immediate attention by the College and University administration. Inadequate space, in both quantity and quality, has been cited already in the last two accreditation reports submitted in 1990 and 1993.

Other than the deficiencies noted above, the baccalaureate degree programs are well conceived, and responsive to the current expectations of the profession and the employers. Although all of the programs exceed the upper limit of 128 credits recommended in the State's *Accountability Measure 12*, it is not reasonable to expect the degree requirements to be reduced. The technical content of the programs is consistent with that of other accredited engineering programs and is in no way excessive. However, extra credit hours mandated by the USF General Education and Exit Requirements place additional credit hour demands well beyond those at a majority of engineering schools. For transfer students, additional credit hour requirements are imposed by the community college articulation agreements. Furthermore, the faculty are attempting to satisfy requests by employers to add such topics, as teambuilding, Total Quality Management, statistical quality control, and foreign languages and cultures.

The report of the USF Planning Commission (September 1992) and the new USF General Education and Exit Requirements exhibit a substantial difference in attitudes toward the significance of "technology" in the education of USF students. The Planning Commission Report states:

> "The pervasive influence of technology on all aspects of intellectual, economic, political and social endeavors during the next century will precipitate changes in the human condition as dramatic as those affected by the Industrial Revolution. The University must be at the forefront in creating new technologies and in preparing its students to use these technologies and to master their implications."

By contrast, there is not even a single reference to technology in the General Education and Exit Requirements. Taking the two documents at face-value, one is left to wonder if all but the engineering graduates from USF will be the 21st century's equivalents of the 19th century "Luddites."

From discussions with students and faculty, it appears that the community college articulation program is "reasonably seamless." However, the existence of such a large transfer population makes it virtually impossible to incorporate any of the innovative approaches to the freshman/sophomore curriculum such as those being developed by the National Science Foundation-sponsored Engineering Education Coalitions. Community college transfer students observed that the educational environment in the community colleges for the foundation courses in mathematics and the physical sciences is more conducive to student learning. Smaller classes and more personal attention were cited as the principal reasons for these observations.

Two new graduate programs are being considered by the College of Engineering, namely, Master of Science in Environmental Engineering and Master of Science in Marine Engineering. The former degree would take the place of two graduate degrees currently being awarded, and would require no changes in the existing course offerings. Based on the rapidly-growing demand for graduates in environmental engineering, this proposed program appears to be a judicious response to the needs of employers.

The proposal for a graduate program in Marine Engineering is in its formative stage. Hence, it is not possible to provide a definitive review. However, with the recent dedication of the USF Joint-Use Marine Research Facility, the concept of such a program is certainly attractive and deserves to be investigated.

The individual departments do not have industrial advisory boards. A college-wide industrial advisory board with appropriate discipline representation is currently being re-constituted. Emphasis will be placed on appointing regional and local industry leaders. It is crucial to have regular input from this very important element of the community. The final appointment of this board should be pursued as quickly as possible.

All undergraduate engineering programs are designated as limited access. Review of the admission standards indicate that the requirements have been established as minimum criteria to ensure a reasonable probability for admitted students to complete their degree programs successfully. The criteria are not being used as an enrollment control instrument. They are reasonable and should be retained.

Students

As a consequence of appropriate admission standards, both undergraduate and graduate students are adequately prepared to pursue rigorous engineering degree programs. All incoming freshman and transfers are initially advised by the College Director of Advising. In most departments, the students have adequate access to faculty members for both academic and professional advising. It appears that significant improvement has been made in maintaining appropriate student records and ensuring adherence to published course prerequisites. Student enrollment and degree productivity for the individual academic programs are within acceptable limits.

Undergraduate students in Civil and Mechanical Engineering must take the Fundamentals of Engineering Examination as a graduation requirement; however, passing the examination is not required. The other departments encourage their students to take this examination before graduation. The passing rate for USF students in 1993-94 was 60 per cent, which is below national and statewide averages. The passing rates may be adversely affected in those departments where taking, but not passing, the examination is required.

Each department has some state support for graduate teaching assistants. The support is in the form of a stipend, and the possible addition of a partial or full tuition waiver. In view of the growth of the student enrollment and the increasing demands on faculty time, additional teaching assistants would improve the effectiveness and the efficiency of the undergraduate programs. The stipend level is reasonable, but somewhat on the low side for the Southeast. Discussion with both graduate teaching assistants and research assistants revealed serious problems with delays in notification of their tuition waivers and an unresponsive graduate admissions process. It is hoped that the University will implement the proposed improvements in the admissions process as quickly as possible.

The College of Engineering and the University provide numerous opportunities for extra-curricular activities which enrich the educational programs. Student chapters of professional and honor societies serve the various disciplines. There are twenty-two different student organizations in the College of Engineering. These student activities appear to have adequate faculty support, office space, and administrative services.

The College of Engineering has a tangible commitment toward appropriate diversity in the student body. Recent growth in the enrollment of African-American and Hispanic students is particularly commendable. The Director of Minority Engineering Programs has developed exemplary programs to improve the retention of minority students. She has conducted a very effective "Bridge" program to assist incoming freshman minority students in making the transition from high school to the College of Engineering.

A Professor of Electrical Engineering has conducted an outstanding Saturday morning enrichment program, known as, "YES, WE CARE." The primary purpose of the program is to increase the number of minority high school graduates who will have the motivation and academic preparation to pursue baccalaureate degree programs in engineering and science. It would be a genuine contribution to the engineering profession to have this program publicized for possible adoption by other organizations on a national level. It is recommended that the Chair of the new

AAES Engineers' Pre-College Council (EPEC) be contacted in this regard.

Faculty

As a whole, the faculty members, including recent hires, possess excellent academic credentials and reasonable industrial experience. Many faculty members are active in professional societies, research, and consulting. The overall level of faculty scholarship, as measured by scientific and professional publications and research activities, is consistent with the mission of the College of Engineering. However, teaching loads for some faculty members are not consistent with the continuing emphasis on increasing the graduate and research programs. Faculty morale in all but one department is still quite positive. Junior faculty members expressed as reasons for coming to the College of Engineering the existence of effective, although informal, mentoring by senior faculty and the freedom to develop their own unique faculty niche.

In most cases, departmental leadership is excellent. The department chairs are energetic, enthusiastic and forward-looking. They are articulate spokesmen for their respective departments and yet are willing to consider seriously the well-being of the College as a whole. They were supportive of the upper administration and committed to the pursuit of excellence in their programs. An excellent *esprit-de-corps* among the department chairs was evident.

Comments by students, faculty, and department chairs suggest that teaching effectiveness is an important part of faculty development and performance evaluation. With two exceptions, the faculty members were considered good to excellent teachers.

The Teaching Incentive Program (TIP) received mixed reviews. On the positive side, some senior faculty members who had been effective teachers earlier in their careers were encouraged to rejuvenate their classroom teaching performance. Some faculty members who were teaching predominantly graduate courses began to request and teach undergraduate courses, with very good student reviews. Most significantly, TIP signals in a tangible way a renewed interest by the upper administration and the Board of Regents in quality undergraduate classroom teaching performance.

On the negative side, the introduction of TIP created measurable confusion for some senior faculty members, who were hired into an exclusively undergraduate teaching environment. In mid-career, they were exhorted to develop funded research programs, and, more recently, were given a substantial salary incentive to return to a focus on undergraduate teaching. Some senior faculty members apparently made the deliberate decision to increase their consulting activities to augment their annual income, rather than pursue the Teaching Incentive Program. The newer faculty members were equally confused. Having been hired into an environment which placed substantial value on research and other scholarly pursuits without any salary increases, these faculty then were faced with TIP as the only option for significant salary enhancement. Many faculty members voiced the opinion that this program will have a limited "lifetime", and is a typical example of "micromanagement" by the State Legislature.

Faculty salaries, in general, are a serious morale problem. The Teaching Incentive Program exacerbated already existing salary issues. In light of apparently minimal salary increases during the last five years, adding $5000 to the base pay for undergraduate teaching performance documented once for a three year period has increased the dissatisfaction of some faculty members. Dissatisfaction was also expressed regarding the distribution of funds specifically designated for salary compression/inversion and equity adjustments, and the apparent practice of "counter offers" to retain productive scholars. Apparently the latter practice suffers more from perception than reality.

Both faculty and administrators expressed unhappiness with the Faculty Activity Report. The current system appears to serve very little useful purpose for an accurate measure of actual faculty productivity or as an instrument to assist chairs in equitably distributing faculty responsibilities. Apparently, no faculty member's activity report can exceed the mandated twelve contact hours, or their equivalent. A rough estimate would translate that workload to 40 clock hours. Most, if not all, engineering faculty members regularly exceed the twelve contact hours, if the recommended student credit hour generation/non-credit generating activities scheme is applied. Hence, the department chair in consultation with the individual faculty member agrees to a sliding scale on other than specific classroom teaching assignments. This *ad hoc* adjustment of the recommended workload measuring system not only defeats the primary purpose of the process, but also makes the University vulnerable to federal auditors questioning the use of academic year faculty research release practices.

The College of Engineering has two funded Eminent Scholars positions. The Endowed Eminent Scholar Chair in the Department of Computer Science and Engineering has been filled by an excellent scholar. Based on a review of his current resume and comments from departmental faculty, he is an outstanding, productive scholar and is providing noteworthy leadership in the area of research and graduate studies. The funds generated by the endowment are being used to support travel, visiting scholars and the purchase of library materials.

The Samuel and Julia Flom Endowed Chair is located in the Department of Civil Engineering and Mechanics. The funds are used to bring in distinguished visiting scholars who give technical presentations and meet with faculty members and students. Past Flom Eminent Scholars have consisted mainly of recognized faculty members from US and European universities. Representatives from engineering consulting firms have also been invited. The impact of these visiting scholars on the graduate and research programs is difficult to assess.

The College has very limited resources for faculty development. At present, the only funds which can be identified specifically for this purpose are from the Research Incentive Program, which returns a portion of the generated research overhead to the principal investigators, department chairs, and college deans. In the past, state funds allocated to the Engineering and Industrial Experiment Station were used in part to support new faculty members in their research, or new research initiatives by more senior faculty. These funds, averaging about $250,000, were not available this year. This is a very serious loss, and every effort should be made to restore them.

The faculty members and the College, as a whole, have excellent linkages to the surrounding industrial community. Employers and local alumni were highly complimentary about interactions with the College of Engineering. One of the premiere programs supporting these industry/university partnerships is the FEEDS program. The USF College of Engineering works with about 80 sites and delivers approximately 100 classes per year. There have been 405 graduate degrees awarded through this program, of which more than one-half are the Master of Science degree in Engineering Management. Currently, the direct cost of this program (not accounting for faculty salaries and fringe benefits) is about $500,000. The state-provided budget is $230,000. Better funding for the FEEDS program is needed.

Facilities and Resources

By far, the most serious problem facing the USF College of Engineering is space. Based on the reports made available during this review, this problem was already identified in 1981. It was identified as a major concern in the 1988 SUS Engineering Education Program Review. ABET accreditation reports to the institution in 1983, 1989, and 1992 cited serious space deficiencies. The problem is two-fold. First, there is simply not sufficient space to support adequately the current programs, faculty, students, and staff. Engineering Building #2 was completed in 1988. It is an excellent facility and houses the Department of Electrical Engineering, the Department of Computer Science and Engineering, computer rooms, classrooms, the central administrative offices, and a student common area. The remaining departments are still housed in cramped offices, laboratories, and classrooms in the Kopp Engineering Building. The available space in this building is not sufficient to meet even the most basic facility needs of the departments.

In addition to its inadequate space, the Kopp Engineering Building is replete with numerous unsafe conditions. Some of these are due to overcrowding, and others are due to poor laboratory management practices. In some case, there is a high probability for human injury. The latter should be addressed immediately. The existence of these safety violations represents an unacceptable environment for the education of future engineering practitioners. Apparently, the current University inventory/ surplus procedures contribute to the problem by forcing the departments to store, for an extended period of time, equipment that is no longer serviceable.

Based on discussions with the upper administration and a review of the 1995-96 proposed PECO New Building and Major Renovation Priorities, the third engineering building containing 108,000 net assignable square feet is currently number seven on the list of priorities. Renovation of the Kopp Engineering Building is number eight. The SUS Five-year Capital Improvement Plan lists these buildings in priority numbers ten and eleven, respectively. The funding for the new building is scheduled from 1997 to 1999, and for the Kopp Engineering building from 1998-2000. These projected improvements will be much too late to influence the outcome of the next ABET visit.

There are also serious instructional equipment needs. Most of the recent ABET accreditation reports cited the lack of institutional commitment to fund the present laboratory plans. When they existed, these plans were essentially viewed as "wish lists." This is inappropriate for programs intended to prepare engineering practitioners. The current national climate for engineering education is increasingly requiring more practical, "hands-on" experience. Many prospective employers are demanding appropriate experience with current equipment and instrumentation. Funds need to be allocated both for the purchase of new equipment and for the maintenance of existing equipment.

Discussions with faculty members and (especially graduate) students suggest that the University provides reasonably adequate library support. The holdings of reference books and the number of appropriate journal subscriptions varied significantly from one discipline to another. A shortage of current references appeared to be a problem in some disciplines but seemed less noticeable in disciplines and subdisciplines with a history of significant funded research.

Computer support, both in hardware and software, appeared reasonably adequate. Opinions by students on the level of support varied from discipline to discipline. Students in the more computationally-intensive projects or courses obviously had higher expectations, and voiced some criticism. In general, faculty, students, and staff appeared satisfied with this area.

As expected for an institution in a growth mode and in transition to a more research-intensive environment, the basic operating budgets and support staff are inadequate. Faculty members are doing too much work that does not directly contribute to their basic responsibilities in teaching, research, and service. Hence, an increase in the support services would be a cost-effective way to significantly improve faculty productivity and the quality of students' educational experiences.

Although the quantity of the support staff is inadequate, the quality and morale of the existing office and laboratory staff are outstanding. The staff members appeared competent, enthusiastic, and extremely supportive of the departmental and College administration. They expressed a genuine interest in the students and their educational experience. Every effort should be made to maintain the quality of the staff and the positive working environment.

Responses to Previous Program Review Recommendations

The USF College of Engineering Institutional Self-Study (September 1994) provides a very succinct and appropriate response to each of the recommendations (both system-wide and institutional) made in the 1988 SUS Engineering Education Program Review. Unfortunately, there has been very little tangible progress made in addressing the recommendations. The recommendations specific to USF are listed below, along with the actions taken in response to each recommendation.

1. USF should renovate the old (Kopp Engineering) building to improve the offices and laboratories with particular attention to relieving the overcrowded conditions.

   Response: The unsatisfactory state of the Kopp Engineering Building continues. It appears that it may have become even more overcrowded and unsafe since the 1988 review.

2. The top administration of USF should try to supply the resources needed for the new leadership of the college to solve the problems of inadequate space, faculty salary compression, and insufficient support personnel.

   Response: As noted above, none of these conditions appears to have improved since the 1988 review.

Strengths and Needs

In spite of the problem areas cited and enumerated in the previous sections of this report, the USF College of Engineering has many strengths including the following.

1. The faculty are qualified, productive and enthusiastic.
2. Support staff are of high quality.
3. Students are qualified, motivated and mature.
4. Good rapport exists among departmental, College, and University administrators.
5. The College is located near a growing industrial community.
6. Sufficient land is available for expansion.
7. The College enjoys an attractive physical environment.

Major unmet needs of the USF College of Engineering include the following.

1. A substantial increase in the quantity and quality of space is urgently needed.
2. Significant salary increases which are related to performance in teaching, research and service are needed.
3. A major need exists for additional staff and faculty to reflect the growth and changing mission of the institution.
4. A funded plan for maintenance, modernization, and replacement of laboratory equipment is lacking.

Recommendations

Based on the issues discussed in the previous sections of this report, the consultants offer the following recommendations.

1. The consultants recommend that every effort be made to move the construction of the new engineering building and the renovation of the Kopp Engineering Building to higher posi-

tions in the capital improvement priority list. In the meantime, the existing space in the Kopp Engineering Building needs to be improved by immediately addressing the most obvious safety violations and by removing all surplus equipment. The latter will require some substantial changes in the University inventory/surplus procedures.

2. The consultants recommend that the Teaching Incentive Program be reviewed with the goal of addressing some of the negative responses to the program.

3. The consultants recommend that evidence of excellence in classroom teaching be significantly expanded to include indices beyond in-class student evaluations. Other evidence such as senior exit interviews (in departments that are not now conducting them), and in-class peer evaluation should be given serious consideration.

4. The consultants recommend that better funding be provided for the FEEDS program.

5. The consultants recommend that the Faculty Activity Report be revised to reflect more accurately the level and distribution of faculty efforts. Using the existing guidelines, each faculty member should report his/her actual activities in contact hours or percentage of effort. This would provide a more realistic indication of faculty productivity, and would assist department chairs to distribute the departmental workload more equitably.

6. The consultants recommend that the University review the need for better balance in the current 45 credit hours of the Liberal Arts Curriculum in light of the pervasiveness of technology in our modern society. It is difficult to conceive that a well-educated citizen of the global community may have no formal introduction to technology, and yet expect "to succeed in our complex world."
7. The consultants recommend that a plan for maintenance, modernization, and replacement of laboratory equipment be developed and implemented, including the identification of potential sources of funding.

Florida Atlantic University

Thomas W. Lester

The Electrical, Mechanical, and Ocean Engineering programs offered by the College of Engineering at Florida Atlantic University (FAU) were reviewed during two visits in October and November 1994. In the following narrative, the strengths, needs, and recommendations relative to program, students, faculty, and facilities and resources are considered.

Educational Programs

Academic programs in the three disciplines that are the focus of this study appear to contain adequate depth, breadth, and currency to provide students with an educational background that prepares them for contemporary engineering practice. The undergraduate programs all enjoy six-year accreditation by the Engineering Accreditation Commission (EAC) of the Accreditation Board for Engineering and Technology (ABET). Interviews with students and with representatives of local industries that employ FAU engineering graduates were generally positive. Both groups felt that students who successfully complete a program of study at FAU were well prepared to compete with graduates from other, better-known engineering schools.

Engineering course work appears to be consistent with the expectations of employers. All three disciplines offer a variety of elective courses that allow students flexibility in career preparation. A number of students work in surrounding industries while attending school. Because of such students' irregular schedules, it is important to offer required undergraduate courses that are part of prerequisite sequences each semester. This appears to be done. It should be noted that there is no formalized co-op program at FAU, although this is becoming a primary method for employers to identify permanent hires. FAU graduates interviewed felt that the College should place greater emphasis on work-related experience for students.

A number of specialized research facilities and centers have been developed during the past five years that have greatly enriched the educational environment for both undergraduate and graduate students. All three departments have made commendable progress towards integrating the research and instructional environment, and FAU appears to be well ahead of many engineering schools in this regard. The Ocean Engineering program, in particular, has done an excellent job in integrating research into the fabric of the instructional environment.

Florida Atlantic University attracts a large number of community college transfer students. In general, engineering administrators and faculty felt that these transfers were adequately prepared in mathematics and science to compete with native students. However, serious problems are created for many of these students by the institutional requirement that at least 12 hours of course work must be taken outside of the major college while in residence on the Boca Raton Campus. It is unfortunate that students who have completed an associate degree at a community college, and, thus, are best prepared for university studies, are the ones most adversely affected by this requirement. It appears that this institutional impediment is at variance with SUS policy on community college articulation.

It is also unfortunate that this institutional impediment, which places extra credit-hour requirements on community college transfers with associate degrees, remains in place at a time when the Engineering College has made significant progress in reducing hours to graduation in the undergraduate programs towards 128 semester hours as recommended by the State's *Accountability Measure 12.* Both faculty and the College administration appeared confident that the reductions have been effected without a dilution of the technical content of the undergraduate engineering curriculum. Further reductions in curricular content appear unwarranted at this time.

Although the FAU College of Engineering is not identified as having limited access, it does limit admission into the upper division through evaluation of the academic record of students in lower division courses. Currently, the College uses different admissions criteria for community college transfers than those for native students. It is not clear to what extent this practice has hindered matriculation of community college students in the undergraduate engineering programs at FAU, but it also appears at variance with SUS policy on community college articulation.

Students

Florida Atlantic University primarily attracts students from South Florida into its undergraduate programs. Over 70 per cent of the undergraduates transfer into the College of Engineering from other institutions or from community colleges. Nearly 60 per cent of the undergraduate students at FAU are part-time. Program data suggest that admission criteria provide adequate selection of applicants. From 1989-90 through 1993-94, an average of approximately 1 in every 5.6 engineering undergraduates received bachelor's degrees. Given the large number of students who are part-time and who transfer from other institutions, this graduation rate appears consistent with reasonably good persistence.

Engineering seniors and bachelor's graduates are eligible to take the Fundamentals of Engineering (FE) examination, which is the first step to registration as a professional engineer. During 1993-94, approximately one third of the graduating seniors at FAU chose to attempt the FE examination. Of that total, 67.8 per cent passed, which compares favorably to the SUS average of 64 per cent during the same year, but is slightly lower than the national average of 71 per cent. The percentage of FAU graduates that take the FE examination appears to be substantially lower than for the SUS as a whole. Nonetheless, it should be noted that FAU does not have a Civil Engineering undergraduate degree program. Nationally, a large percentage of registered engineers are civil engineers; therefore, it is not surprising that a lower percentage of FAU's students choose to attempt the FE examination than students from institutions that offer civil engineering.

The graduate student population is relatively balanced between U.S. citizens and non-resident aliens. In comparison to national averages, FAU appears to have a slightly higher percentage of U.S. citizens among its graduate students, which is commendable. Graduation rates for MS degree students have averaged approximately 1 in every 3.2 students over the past 5 years, while the graduation rate of PhD students has averaged 1 in 6.8 students. The graduation rate for the MS program appears very good, while that for the PhD program appears to be low. It is not clear whether this is reflective of the quality of the students in the PhD program, or of external factors such as part-time status. Nearly 55 per cent of the graduate students at FAU are part-time, which may explain the reason for the lower than expected graduation rate for PhD students.

The College of Engineering has experienced significant growth (approximately 45 per cent) over the past five years. The current headcount student to faculty ratio in the three programs is approximately 19. In comparison, many strong engineering programs, such as those at Virginia Tech, have ratios in excess of 20. Nonetheless, these programs have substantially greater resources per student than does FAU. Any further enrollment growth must be accompanied by appropriate resources for programmatic support and for faculty positions.

One particular problem that presents itself is the declining support for teaching assistantships. Since the 1991-92 budget year, there has been a decrease of 15 per cent in the funding for graduate teaching assistantships. It must be emphasized that this has occurred at a time of modest, but continuing increase in undergraduate enrollment and during a time of rapid expansion of the graduate research program. At an assumed average stipend of $12,000, the number of teaching assistantships in the College is far below that at most comparable schools. Currently, FAU has an authorized teaching assistant/faculty ratio of approximately 1 to 7, while a ratio of at least 1 to 2 is probably necessary to provide adequate support for a faculty that is actively engaged in scholarship as well as in teaching.

Degree productivity is adequate for all programs in the College. A reasonable guideline for assessing the viability of academic offerings is that doctoral degree programs should average at least 3 graduates per year, that master's degree programs should average at least 5 graduates per year, and that bachelor's degree programs should average at least 10 graduates per year. FAU's engineering programs all satisfy these criteria, with the exception of the recently instituted master's degree in manufacturing. Given the remarkable growth rate (in excess of 90 per cent) of both the master's and doctoral degree programs over the past five years, there is no doubt that FAU's graduate engineering programs (including the masters in manufacturing) are viable and improving rapidly.

The University and the College are to be commended for their emphasis on advising and the positive steps they are taking to promote diversity in the engineering student body. An effective advising program has been developed by the College through its recently formed Division of Engineering Services. Professional staff are assisted by faculty, who are required to attend a training session prior to being permitted to advise freshmen students. FAU has also made a significant commitment to the recruitment and retention of minority students. The undergraduate enrollment percentages for African Americans and for Hispanic Americans at FAU are 12 per cent and 10.8 per cent, which compare reasonably well to SUS averages of 14.2 per cent and 13.1 per cent respectively. While these percentages are slightly below those for the System, minority graduation rates are equal to or greater than SUS averages. The most recent data from FAU indicate that the persistence of both African Americans and Hispanic Americans is greater than for the SUS as a whole. At FAU, 14.4 per cent of the 1993-94 baccalaureate engineering graduates were African American, and 12.4 per cent were Hispanic American. This compares to 7.0 per cent African American and 12.3 per cent Hispanic American for the SUS as a whole. The retention rate of African Americans relative to the student population as a whole is especially commendable.

The College is also doing a commendable job of recruiting and retaining women. It is noteworthy that the College has neither a chemical engineering nor an industrial engineering program, both of which traditionally have the largest percentages of women engineering students. Nonetheless, FAU's proportion of 19.0 per cent women among engineering undergraduates is greater than the SUS overall average of 18.5 per cent.

Faculty

The Engineering College and University administrations are to be commended for assembling a faculty that is highly competitive nationally in grant and contract acquisition and is dedicated to effective instruction. About 75 per cent of the faculty are active in funded research, quite high for so young a college. Also commendable is the active recruitment of outstanding faculty candidates who are female or African American. Faculty and students alike were positive about the environment that exists in the College for minorities.

A major problem facing the College is the relatively high percentage of faculty who are tenured. This is all the more troublesome because the College has not been afforded the opportunity recently to hire new faculty because of budgetary constraints, and most of the existing faculty are not close to retirement age. The infusion of faculty on a routine basis is essential to maintain the vitality of an academic unit. Deprived of new faculty, departments may atrophy intellectually and lose the vitality so necessary for continued academic improvement.

No teaching evaluations were available for inspection; therefore, all information about the effectiveness of instruction was gathered from interviews with faculty, students, and alumni. Faculty from all three units appeared to be committed to high quality instruction, and students and alumni generally gave the faculty high marks for teaching effectiveness. Students were especially positive about the learning environment in Ocean Engineering. Most negative comments from alumni and students were directed towards a small group of faculty who were neither intellectually active nor especially effective as teachers. Although this represents only a small fraction of the engineering faculty, it poses a real challenge to the College and University administration to implement creative approaches to faculty re-engagement.

The College administration has provided effective leadership during a period of budgetary pressures and substantial enrollment increases. The dean is a highly respected academician in his own right, has execellent knowledge of national trends, and sets high standards for himself and his colleagues. He has a dedicated staff who have helped him implement initiatives in advising, minority recruitment, and laboratory enhancement.

Departmental leadership is quite sound overall, especially in Ocean Engineering where continuity of leadership with strong senior faculty support has enabled the department to maintain its vitality, even in the face of loss of positions and budgetary constraints. Ocean engineering faculty are cohesive and appear to believe that theirs is a department of destiny. Faculty were concerned about collective issues, particularly the gradual attrition in faculty lines over the past five years. This has left the program less well rounded than before and presents a challenge to the College administration to preserve a superior program, while still addressing the pressing needs in other departments.

The faculty in Electrical Engineering also appeared to be cohesive and supportive of the chair. Substantial progress has evidently been made in developing a nationally competitive electrical engineering graduate program. Faculty morale was generally good. As in Ocean Engineering, faculty concerns focused on collective issues, especially lack of space and antiquated equipment.

Mechanical Engineering presents the greatest challenge to the College and the University. Faculty appeared to be divided, and it is apparent that there has been substantial discontent over numerous issues. Unlike Ocean and Electrical Engineering, faculty concern focused on individual compensation, even though laboratory space and equipment appeared to be less adequate than in either of the other two units. Although faculty salary remains a critical issue, the focus on individual, rather than on unit, problems emphasizes the extent of the divisions within the unit. The chair appears to be capable and sensitive to the concerns of the faculty. Nonetheless, he will find it difficult to effect positive change in the department without a cohesive faculty.

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The wise selection of distinguished senior faculty has greatly enhanced the development of the intellectual enterprise in the College. Both the Eminent Scholars are internationally recognized scholars and have developed unique research programs. Both, in their own way, are exercising profound influence upon the development of younger faculty and students. Both are important intellectual resources for the South Florida region. Due to the interdisciplinary nature of their endeavors, they are promoting linkages among multiple departments and centers in the College. However, the nationally prominent programs initiated, such as high definition TV, are fragile in their excessive dependence on external funds. A faculty position which provides a colleague to the Eminent Scholar would strengthen the program.

In general, the Engineering College appears to be promoting adequate cross-disciplinary and external linkages, although the extent of these varies widely. Ocean Engineering has established excellent ties to local industry, and to complimentary academic programs at other SUS institutions, notably the University of South Florida. Electrical Engineering, principally through Professor Glenn and through the Robotics Center, is following that lead. Mechanical Engineering faculty, in general, do not appear to have sufficient ties to local industry, or to other units on campus. Local industries appear to welcome such interaction and the positive contributions that engineering faculty and students make to corporate well being.

Faculty compensation is a critical issue to the maintenance of educational quality of the College. Faculty salaries, on average, are at least 10 per cent below the averages at comparable institutions. The discrepancy becomes more pronounced at the professor level. The salary issue is exacerbated by the almost complete lack of budgetary provision for faculty professional development. Were it not for direct charges to grants and contracts, or for the farsighted return of indirect costs to the College, it would be impossible for faculty to engage themselves effectively with their disciplinary peers. As it is, faculty express varying degrees of frustration over the lack of institutional support for salaries and professional development. The problem appears to be most pronounced in Mechanical Engineering and less so in Electrical and Ocean Engineering.

Facilities and Resources

With the possible exception of faculty salaries, space is the most critical issue facing the FAU College of Engineering. Due to rapid growth in its research and graduate programs, the College possesses inadequate laboratory space for either contemporary engineering education or for further development of research and graduate study. The move of most research activities in Ocean Engineering from the Boca Raton Campus to Sea Fair will lessen the space problems for that department. However, it should be noted that this move will almost certainly harm the wonderfully synergistic relationship between research and instruction that is currently a hallmark of the Ocean Engineering Program. Space needs for research in Electrical Engineering are especially acute, as are space needs for instruction in Mechanical Engineering. The laboratory space deficiency in Mechanical Engineering is of such consequence that future accreditation of the program may be jeopardized unless some relief is forthcoming.

Computing resources in the College are wholly inadequate for a campus that prides itself on its role in technology development in South Florida. Were it not for innovative arrangements with Motorola, the computer facilities would be sufficiently deficient for the Accreditation Board for Engineering and Technology (ABET) to downgrade the accreditation of the undergraduate programs. Students lack adequate provision for e-mail or computer accounts. E-mail for students could be especially helpful, since so many students are part-time and may find it difficult to find faculty in their offices at convenient times.

Support for equipment and computing needs in the College is generally inadequate. Continuing accreditation of the undergraduate programs will require an adequate and identifiable source of funds for continual upgrade and maintenance of equipment and facilities. Current accreditation was based on the premise that these funds would be available. Subsequent budget reductions deprived the College of such funds. Given this situation, it is worth noting that well over half of all colleges of engineering nationally charge additional fees to engineering students to cover the added expense of engineering education, especially laboratories and computers. These fees range upwards to $500 per academic year. Current laboratory fees at FAU are woefully inadequate. Given the current inability of the State to provide adequate support for FAU engineering instructional facilities, it may be necessary to levy additional fees on students to sustain viable and accredited undergraduate programs.

It must be noted that the rapid development of the research program and the maintenance of the undergraduate programs during a time of severe institutional budgetary constraints can almost certainly be credited to the farsighted policy of the University to return a sizable percentage of the indirect cost generation to the College. The institutional leadership should resist the temptation to reduce this return, given the inadequate nature of general fund support for program, equipment, and computing needs in the Engineering College.

Shortcomings in library holdings were viewed with alarm throughout the College. The reductions in scientific and technical periodicals caused by budget cuts have severely impacted both faculty and students. No study has been conducted on the comparison of holdings or budget in the science and technology area, and it is recommended that the Institution immediately embark on such a survey as an aid in determining what additional resources may be required. Deficiencies in holdings notwithstanding, it was reassuring to hear the faculty speak positively about the response they receive from the library staff. Likewise, the director of the library was acutely aware of the shortcomings in scientific and technical collections, and was doing his best to overcome these through the deployment of electronic databases, use of interlibrary loans, etc.

A final note is in order about the support staff in the College. Faculty and students agreed that these individuals were outstanding and dedicated to the support of both instructional and research programs. It should be noted that the staff paid through general fund revenues would be far short of that necessary to support the current scope of programs in the College. It is only through the use of indirect cost return that a staff of sufficient size has been assembled.

Responses to Previous Program Review Recommendations

Three recommendations regarding the engineering programs at Florida Atlantic University were offered at the time of the most recent (1988) SUS Engineering Education Program Review. These are listed below, along with the actions taken in response to each recommendation.

1. The request to offer the master's degree program in Civil Engineering should be approved.

   Response: This program was approved and the degree first offered in 1988. Since that time, FAU has graduated an average of 10 students per year with master's degrees in Civil Engineering.
2. Planning for the bachelor's program in Civil Engineering should be delayed until the master's program is firmly

established and a documented demand for the undergraduate program is shown to be in the best interests of FAU and the State.

Response: Implementation of this degree program is included in the five-year plan of the College. Given the currently inadequate fiscal resources and the critical space situation, it is difficult to recommend that the SUS move ahead with the implementation of a bachelor's degree in Civil Engineering. While there has been no formal study to assess the demand for bachelor's-level civil engineering graduates from FAU, the very successful master's degree program in Civil Engineering must be taken as an indication of the local demand. Should the Institution be able to assist the College in resolving the space issue, and should resources be identified that could be reallocated in support of a bachelor's program in Civil Engineering, it is recommended that planning continue toward eventual implementation of the program when adequate resources become available. Civil Engineering is a core discipline of all major engineering colleges, and an important contributor to the economic development of any region. A Civil Engineering bachelor's degree program is a needed addition for FAU's College of Engineering to develop to its fullest potential and for the South Florida region to address pressing infrastructure needs adequately.

3. Planning should continue on the bachelor's degree in Computer Engineering, with this program closely allied to Electrical Engineering in the single administrative structure of the Department of Electrical Engineering and Computer Engineering. Close liaison should be established with the Computer Science Program.

   Response: This degree program was implemented in Fall 1993. Computer Engineering was joined with Computer Science in a combined Department of Computer Science and Engineering.

Strengths and Needs

It is clear that the College of Engineering at Florida Atlantic University has made impressive strides since the last SUS review in 1988. A number of strengths have been identified in the foregoing narrative, as have specific needs. Major strengths of the College include the following.

1. The College exhibits a strong commitment to academic advising and to diversity of students and faculty. The retention rate of African American students is commendable, as is the overall percentage of women, considering that the College offers neither chemical or industrial engineering majors. Faculty and students reported a positive environment for women and minorities in the College.
2. The faculty is well qualified and includes some truly distinguished senior members; the faculty shows both a high

degree of success in obtaining outside research support and sincere dedication to effective instruction.

3. College and departmental leadership is effective.
4. Successful relationships are maintained with industry and other universities in Ocean Engineering, and industrial linkages with Electrical Engineering are growing.

Due to the budgetary problems that continue to plague the Institution, and the rapid growth in the engineering programs, there are several acute needs that must be addressed to assure the continued growth and vitality of FAU's College of Engineering. These include the following.

1. Space is critically needed for laboratory development in all programs reviewed. Space needs are particularly intense for the undergraduate laboratories in Mechanical Engineering and for the research laboratories in Electrical Engineering. Space is not currently available to sustain a bachelor's degree program in Civil Engineering or for expansion of existing Civil Engineering research activities.
2. Budgetary support for upgrade and maintenance of laboratory and computer facilities is currently inadequate. These deficiencies, together with space inadequacies noted above, jeopardize continued accreditation of the undergraduate engineering programs.
3. Salaries of engineering faculty are generally deficient with respect to national norms, especially for full professors.

4. Well prepared students from the Community College System are penalized by the institutional requirement that all students complete 12 hours of course work in residence at FAU outside their major college. This requirement appears to be at variance with articulation agreements between the SUS and the Community College System.
5. The College of Engineering uses different criteria to determine the admission of Community College students into upper division programs than it does for native students. This practice also appears to violate the articulation agreements between the SUS and the Community College System.
6. A high percentage of the faculty is tenured in. There is a need to replenish the faculty with some new hires.

Recommendations

In accord with the above findings, the consultants offer the following recommendations.

1. The consultants recommend that the institution identify space to sustain an accredited Mechanical Engineering undergraduate program, and to foster the development of graduate programs in Electrical Engineering.
2. The consultants recommend that special funding for upgrading and replacing laboratory and computer equipment be established to assure continued accreditation of all undergraduate programs, and to foster the further development of research programs. Absent such support, the Institution

should consider the implementation of differential fees for engineering students to support these needs.

3. The consultants recommend that the SUS give consideration to a salary adjustment initiative for engineering faculty to assure that FAU and other SUS institutions do not lose the strong faculty contingent that has been assembled over the past decade.

4. The consultants recommend that admission and graduation requirements at FAU identified above that discriminate against community college transfer students, especially those with associate degrees, be discontinued.

5. The consultants recommend that if adequate space and resources can be identified, planning be continued for the implementation of a bachelors degree program in Civil Engineering as soon as practical. The undergraduate and graduate degree programs in Civil Engineering should be administered ultimately by a separate Department of Civil Engineering. The planning process, as set forth in the report by Ara Arman of Woodward-Clyde Consultants, should be followed in establishing the program.

6. The consultants recommend that the institution continue its farsighted practice of returning 60 per cent of the indirect costs generated in the College. In view of inadequate State support for program needs, this policy appears to be critical to the ability of the College to continue to offer high-quality undergraduate and graduate programs.

7. The consultants recommend that the institution invest in the nationally prominent programs, such as high definition TV, so that funding agencies can see evidence of institutional commitment and the important strides made are not lost.

8. The consultants recommend that the institution and the College find means of reengaging the small group of faculty who are neither research active not especially committed as teachers.

9. The consultants recommend that the faculty be replenished with some new hires so that departments do not atrophy intellectually.

University of Central Florida

V. Thomas Rhyne

Educational Programs

The University of Central Florida (UCF) College of Engineering offers seven undergraduate engineering programs, all of which are currently accredited by the Engineering Accreditation Commission (EAC) of the Accreditation Board for Engineering and Technology (ABET), plus two undergraduate technology programs currently accredited by the Technology Accreditation Commission (TAC) of ABET. In addition, the College offers fourteen Master's and six PhD programs. New engineering programs recognized in the SUS Master Plan for development at UCF include Master's Level programs in Aerospace Engineering and Optical Science and Engineering and a Doctoral Level program in Optical Science and Engineering. The 1994 enrollment in the college is about 3,600 students (2,700 undergraduates and 900 graduate students), including 680 women students and 500 minority students.

Review of the curricular materials provided by the institution indicated that the curricula for all current UCF engineering programs appear to be up to date. Texts are well chosen and of recent vintage, and supplementary materials are used to provide the most current learning experiences. Graduate-level coursework appears also to be appropriately close to the state of the art. UCF participation in the Florida Engineering Education Delivery

System (FEEDS) is strong, with current UCF courses being provided to students in videotape form throughout the central Florida region. UCF professors were observed as their lectures were being taped for FEEDS use, and their abilities to be effective in both the actual classroom and on tape were noteworthy.

All of the UCF baccalaureate engineering programs except Aerospace Engineering require 132 semester hours. Aerospace Engineering requires 136 hours, but this program could probably be reduced to 132 hours without seriously affecting breadth or depth of curriculum. Suggestions such as *Florida's Accountability Measure 12* which would reduce the hours required to earn a Bachelor's degree to 120-128 credits, if actually implemented, will likely leave the UCF engineering curricula below the level of technical depth expected in accredited programs in most, if not all, engineering areas. This situation is exacerbated by the State-mandated Associate of Arts degree and community college articulation program as well as the University's general education requirements, factors that add several hours to the engineering degrees at UCF which otherwise would be available for courses more directly related to engineering. Having those courses in the current programs is not necessarily a disadvantage (and may even be considered as a means for providing additional breadth to the UCF undergraduate experience), but should the undergraduate curriculum be reduced below the current 132 hour value, key engineering courses would likely be lost, quality will suffer, and accreditation could be in jeopardy.

The state-mandated articulation program is a major issue for all Florida engineering schools in that it appears few community colleges can teach the sophomore mathematics courses that form the base of engineering curricula to the same standards as the engineering colleges. As a result, community college students with the Associate of Arts degree too frequently arrive at upper-level institutions with missing courses or with inadequate preparation in key courses such as mathematics. In keeping with its decision to be a "partnership university," UCF has been proactive in helping potential engineering transfer students avoid this problem, working directly with the local community colleges such as Valencia, Brevard, and Seminole. UCF engineering advisors work with advisors at these community colleges to define model curricula and to help those advisors identify proper courses of study for students planning to move to UCF to study engineering. UCF engineering faculty members also work with the teaching staff at these colleges to make sure that key courses such as engineering mathematics are properly taught. Also, UCF teaching staff teach several key engineering courses (Statics, Probability and Statistics, as examples) via distance learning to the Valencia Community College site as a means of assuring that potential transfer students are properly prepared for a smooth transition to junior-level engineering work when they arrive at UCF, assuring them that graduation following two years of study at UCF beyond the Associate in Arts degree is achievable. The results of this cooperative approach to articulation appear to be quite positive, and this partnership approach could easily be used as a model for other Florida engineering institutions.

At present, the SUS has approved for development new programs in Aerospace Engineering (MS level) and Optical Science and Engineering (MS and PhD levels). The Aerospace MS program appears to be an appropriate new program given recent enrollment levels in the UCF undergraduate Aerospace Engineering program. Also, the development of graduate-level programs in Optical Science and Engineering appears highly appropriate in that UCF houses a nationally recognized graduate research and development center in this area, the Center for Research and Education in Optoelectronics and Lasers (CREOL). Faculty strength to offer a doctoral program in this area is clearly available. Optics is a major national focus for federally funded research aimed at fostering industrial growth (recent announcements for the ARPA Technology Reinvestment Program and the NIST Advanced Technology Program both cited optoelectronics as a key focus area, for example), and industrial growth in this area of advanced technology is forecast to result in a strong demand for graduates with these skills and knowledge. Given UCF's eminent position in this growing field, proceeding with these latter two new programs appears to be a wise decision for the SUS, leading to significant employment opportunities for UCF graduates of those programs, coupled with likely expansion of industrial activity in the optics fields in the Orlando high-tech area as well as elsewhere in the State of Florida.

UCF has had, for some time, an engineering advisory board formed from leaders of local technology industries. Under the new dean, this practice has been continued, selecting advisory board members who can provide experienced insight into UCF engineering operations as well as offer support for the College of Engineering in more tangible ways. This advisory board meets twice each year.

Students

Enrollment within the UCF College of Engineering has been steadily increasing over the past two decades, averaging over six per cent growth in each of those years. Forecasts for the central Florida region indicate that this growth can be expected for the next decade, as well, placing significant pressures on the faculty and physical facilities available to the College.

Admission standards for students who enter UCF directly from high school appear to be appropriately set, following the SUS minimum eligibility index standards. UCF generally has more applicants than it can admit, given its current faculty and facilities, and uses selection criteria to identify those applicants who are judged to have the greatest chance of academic success, tempered by UCF institutional goals for increased cultural diversity in all programs.

Enrollment in all UCF engineering programs appears to be at levels which clearly justify continuation of those programs. This appears to be true for both the undergraduate and graduate programs, and plans for new graduate programs do not appear likely to jeopardize enrollment levels in existing UCF engineering programs.

Given the current limitations of faculty size and physical facilities available to the UCF College of Engineering, UCF's use of limited access to control enrollments appears not only to be appropriate, but also to be necessary to keep the engineering programs at a size commensurate with its resources.

Undergraduate degrees from the UCF College of Engineering have increased from about 200 per year to 300 per year over the past five years. Graduate degrees have increased from about 100 per year to 150 per year over the same period. These data show that UCF has been effective in moving its student population, including a large number of part-time students who hold jobs while working to earn engineering degrees, forward to graduation.

Among SUS institutions, UCF had the largest number of engineering students attempt the Fundamentals of Engineering Examination in 1992. Of those only 42 per cent passed the examination, however, ten percentage points below the statewide average of 52 per cent. Of note is the change made at UCF in 1993 regarding this examination. Prior to 1993 all engineering students were required to take that examination. As of 1993, only students in programs where licensure is likely to be required for engineering practice (Civil Engineering and Environmental Engineering, as examples) have been required to take the examination. The passing rate for those students in 1993 was 66 per cent, 4 per cent above the statewide average. Even with the change, UCF continued to have the largest number of students taking the Fundamentals of Engineering examination among the SUS engineering institutions.

The availability of graduate teaching assistantships and the level of their stipends do not appear to be problem areas within the UCF College of Engineering.

UCF provided detailed information about the placement of recent engineering graduates, indicating that an appropriate tracking system is in place.

Support for student engineering organizations appears appropriate, although the space available for club offices and related activities (tutorial sessions, club meetings, socials) is limited by current facilities. Completion of the second phase of the CEBA III building should help with this space problem.

Advising for UCF engineering students appears to be well done, including the advising of students who transfer to UCF under the articulation agreements with local community colleges. The outreach program to those students which were mentioned above are especially noteworthy.

While an "appropriate" distribution by race and gender is difficult to define, it is clear that UCF in general and the UCF College of Engineering in particular, have worked both hard and effectively to improve the diversity of both their student bodies and their faculties. The UCF College of Engineering maintains programs for the recruitment and retention of both female and minority students. As a result, the College currently reports having 15 per cent minority students and 19 per cent women students in engineering, both of which percentages are above national averages. These percentages represent an increase of one per cent each over the past year.

The partnership between UCF and the University of Puerto Rico at Mayaguez, a major engineering and computer science university in Puerto Rico, also offers opportunities for UCF to increase its Hispanic engineering student population.

The UCF partnership with NASA to provide the Summer Program for Academic Careers in Engineering (SPACE) is also noteworthy as an approach to identifying and recruiting minority students into the UCF engineering student body.

Faculty

The UCF engineering faculty numbers 105, of which eleven are women (eleven per cent) and seven are minority (six per cent). These proportions compare favorable with national averages of five and one per cent for women and minority engineering faculty, respectively. Nevertheless, the need to seek well-qualified female and minority faculty members for UCF, as with all other U.S. engineering colleges, is on going. The current faculty size is marginally adequate for the current instructional and research activities of the College.

Leadership at both the College and departmental levels appears to be excellent within the UCF College of Engineering.

The reported distribution of faculty effort between teaching, research, and other forms of service is judged appropriate to the UCF mission. Teaching quality appears to be excellent, and UCF faculty demonstrate effectiveness in relating to local and national industries. Their involvement in professional activities also appears to be at appropriate levels.

While not evenly distributed across all UCF engineering faculty, the general levels of contract and grant activity within the UCF College of Engineering are excellent. Some effort to broaden research programming would seem to be a positive step, although given continued expansion of teaching loads as student populations have increased, this may prove a difficult goal to achieve. Also, given recent attrition of State funds for research initiation such as EIES funding, expansion of research activities into new areas will be difficult.

No problems with internal cooperation within the College of Engineering were observed. The Dean appears to be well liked and effective in dealing both with the university-level administrators and with the department chairs and faculty within the College. UCF appears to be doing an excellent job of working with a number of external institutions including its neighboring industries and community colleges as well as sister institutions. The University's identification as a "Partnership University" appears appropriate.

Current UCF salaries for engineering faculty and staff appear to be adequate on a regionally adjusted basis, but as UCF moves forward as a major R&D institution, keeping research faculty with current salary levels will be difficult. This concern is especially significant in the case of minority faculty, who are in high demand by institutions that are willing and able to pay higher salaries. There appears to be a strong need for the SUS to look into salary and other financial incentives for research-oriented engineering faculty members--especially minority faculty members--who demonstrate superior research capabilities. Otherwise, Florida, with its access to a strong pool of minority graduate students, may simply become a farm club for other institutions willing and able to pay higher salaries. The limited faculty development funding appears to restrict faculty activities outside teaching. New funds for faculty development are needed.

Facilities and Resources

Physical facilities for engineering at the University of Central Florida are badly overcrowded. At the time or the last Engineering Program Review (1988) it was recommended that the CEBA III building be completed to provide needed additional space for the College of Engineering. The State split the construction of CEBA III into A and B phases, with the A portion of the building nearing completion at the time of the 1994 review visits. This partial space is, of necessity, being largely assigned to research space for the Electro-Optics Institute, however, and while that is an important UCF need, the provision of this space does not address the cramped teaching and laboratory space problems which led to the 1988 recommendation, as well as needs for faculty offices and offices for student organizations and graduate-student researchers. Funding for constructing the remainder of the planned building clearly needs to be appropriated so that construction can be started as soon as possible.

Of note is the decision by UCF to acquire the Pavilion Building in the UCF Research Park, assigning most of that new space (about 77,000 sq. ft.) to the College of Engineering. While this acquisition will provide much needed office and laboratory space, the acquisition does not provide funding for new equipment as would be the case with a new State-financed facility, exacerbating the need for stable sources of funding to operate, repair, upgrade, and replace the College's laboratory facilities.

Somehow, over the past several years UCF has managed to handle effectively a 40 per cent increase in student enrollment during a period when its funding from the state has only increased by 14 per cent! Limited resources are clearly a statewide problem for Florida engineering institutions, and continued expansion of those programs to other institutions (despite previous review recommendations) will only make the situation worse, possibly leading to problems with future ABET/EAC accreditation actions. UCF offers the State a unique opportunity for investment in engineering programming. Orlando is a major high-tech growth area, and UCF has proven to be very effective in establishing links to local industries, including those in its Industrial Park.

A specific problem in financial resources is the apparent loss of EIES funding to UCF. These funds have served as much needed seed funds for new projects, the lifeblood of expansion. Companies view such investments as a necessity, even in difficult financial periods. The State of Florida must recognize the need to provide some reasonable amount of such funds to all of its engineering institutions, and UCF's positioning within a growth region for Florida high-tech clearly justifies the receipt of a significant portion of those funds.

UCF is well-positioned to use EIES funds to support expanded interactions with Florida industries, given its location within the state's high-tech central area, plus the success with which industries have elected to participate in the UCF research park adjacent to the main UCF campus. Investment of "seed" funds via EIES or some other initiative which brings industry-oriented funds to UCF appears to be an excellent opportunity for investment with a highly likely payoff in the creation of new industries (bringing new jobs and new tax base) to Florida.

Office space for UCF engineering faculty and teaching assistants is cramped, limiting expansion. Completion of the CEBA III building offers possible relief for this situation, as does the acquisition of the Pavilion Building.

A shortage of laboratory space appears to be the major limitation to expansion of either educational or research programs within the College of Engineering. The current space limitations force multiple sections of key laboratory courses, as space problems prevent expansion of student workstations even when additional equipment could be obtained. Comparative evaluations of UCF laboratory space per upper-division student shows UCF at about 50 per cent of that available at a number of peer institutions. The acquisition of the Pavilion Building will provide some new laboratory space, although it is located about 1/4 mile from the main College of Engineering facilities.

Classroom space, while not identified as a major current problem, is a potential limiting factor on expansion of UCF engineering programs. Only limited commons space for students appears to be available. Departmental conference rooms are available, although with faculty growth these facilities are becoming more and more cramped.

Research facilities within the UCF College of Engineering are becoming more and more cramped. The completion of the "A" part of the CEBA III building will provide some relief as the Electro-Optics Institute moves into that new space, but since many other engineering research projects require highly specialized space, that new building will not eliminate the need for additional research laboratory space at UCF.

The state of instructional laboratory equipment at the UCF College of Engineering has been judged to meet minimum standards expected for accredited engineering programs. Continued funding for upgrading, maintenance, and replacement is a necessity to maintain those standards, however, and the lack of sufficient Operating Capital Outlay (OCO) funding will likely make the marginal current situation become worse. The College and the University have plans to increase the allocation of monies to improve laboratory holdings and space.

While funding for office support and personnel services needs to keep pace with faculty/staff expansion, no specific problems were observed in this area at present.

Responses to Previous Review Recommendations

The most recent SUS Engineering Education Program Review (1988) contained two recommendations for the UCF College of Engineering. These are listed below, along with the actions taken in response to each recommendation.

1. The proposed building (CEBA III) should be given a high priority on the PECO list. In the interim, space for research should be leased, possibly in the research park.
   Response: As noted above, construction of CEBA III was split into A and B phases, with the A portion of the building nearing completion at the time of the 1994 review visits. This space will be insufficient to accommodate the general instructional and research needs of the College because of the need to assign a portion as research space for the Electro-Optics Institute. The recent assignment of a portion of the Pavilion Building in the UCF Research Park will provide much needed office and laboratory space for the

College but no needed funding for new equipment as would be the case with a new State-financed facility.

2. The institution should accelerate its search for a new dean and make a selection before the end of the year.

   Response: A new dean was appointed but was promoted to UCF Provost in 1993. His replacement was selected from within the UCF engineering faculty, and appears to be very effective in his new position.

Strengths and Needs

The following are judged to be strengths of the UCF College of Engineering.

1. The College maintains close and effective working relationships with the community it serves in central Florida.
2. By partnering with the large technologically oriented industrial base in the Orlando area, as well as with the community colleges in that same area, UCF is offering highly relevant educational and research programs in engineering to the students and employers in that growing region of the State.
3. The College has a well-qualified and dedicated faculty, who are effective in teaching and research.
4. The Dean and the department chairs provide strong, effective leadership for the College.
5. The College has made significant progress in enhancing the racial, cultural, and gender diversity of its student body and faculty.

Major unmet needs of the UCF College of Engineering include the following.

1. The UCF College of Engineering is experiencing a serious shortage of space for its instructional and research programs.
2. The size of the UCF engineering faculty has not kept pace with recent enrollment growth.
3. Funding for laboratory equipment replacement and modernization and to support research initiation is inadequate.

Recommendations

The consultants offer the following recommendations:

1. The consultants recommend that the "B" part of the CEBA III building be completed as soon as possible.
2. The consultants recommend that UCF consider providing specialized stipends for well performing minority faculty as a means of improving retention.
3. The consultants recommend that the University review the needs of the College of Engineering for expanded laboratory space and equipment, and develop a long-term plan for addressing these needs, supported by assured sources of funding.
4. The consultants recommend that the University seek to develop stable funding for research initiation, such as EIES.

Florida International University

Leroy S. Fletcher

The College of Engineering and Design at Florida International University is continuing to grow in both visibility and reputation, and is becoming the leading engineering college in southeast Florida. The continued growth of the greater Miami area, the emergence of new industries, and the increasing concerns for the environment, suggest that the College of Engineering and Design is at the threshold of both opportunity and responsibility.

The Florida Board of Regents is to be commended for its foresight in establishing and supporting the development of an engineering program for the residents of southeast Florida. While it is recognized that in today's economy there are numerous constraints on higher education, including limited resources of budget, space, faculty, facilities, and support personnel, the continuing need for facilities, space, and personnel to meet the needs of a growing multiracial, multicultural region must not be overlooked in the quest for quality engineering programs. Continuing support is essential to the maintenance of strong accredited engineering programs for southeast Florida.

This report will focus on the issues specified by the Board of Regents, including Program, Students, Faculty, Facilities and Resources, Responses to Previous Program Review Recommendations, Strengths and Needs, and Recommendations, as well as other issues deemed relevant to the progress of the College.

Educational Programs

Significant progress has been made with strengthened engineering programs, improved academic advising, and an increased focus on design and project-related education. All undergraduate engineering curricula are accredited by the Engineering Accreditation Commission (EAC) of the Accreditation Board for Engineering and Technology (ABET); the Civil and Computer Engineering programs were most recently accredited in the Fall of 1994.

The general education requirements for all SUS institutions, the engineering CORE curriculum, and the engineering humanities and social science requirements, combined with the ABET program requirements for each engineering curriculum provide appropriate depth and breadth in the undergraduate engineering programs. Further, the engineering courses are appropriately sequenced from the fundamental level to advanced applications, providing engineering programs which are current and timely.

The average numbers of credit hours to attain the undergraduate engineering degrees are appropriate and consistent with accredited engineering degree programs across the country. Although some programs require slightly more than the 128-hour maximum recommended in the State's *Accountability Measure 12*, the excess does not appear to result from unneeded technical course requirements, which appear consistent with those typical of accredited programs. However, the University general education and completion requirements are more extensive than those at many engineering schools and lead to higher overall degree requirements.

At the graduate level, the number of credits required for MS and PhD degrees is appropriate and consistent with other institutions around the country. However, it may be desirable to review the MS degree requirements to assure their competitiveness with peer institutions.

The articulation agreements with Broward Community College and Miami Dade Community College facilitate the transfer of students to the engineering program at Florida International University. The recent establishment of a Director of Academic Support Services in the Office of the Dean of Engineering should improve the integration of transfer students into the engineering program. While the community college transfer students are viewed as older and more mature, it is not clear that their academic preparation is adequate for engineering due to perceived lower admission requirements, level of instruction, and limited competition. The large number of such students may serve to dilute the overall quality of the engineering program.

The baccalaureate engineering programs at FIU are considered to be open access programs.

The addition of a PhD degree program in Mechanical Engineering is appropriate, timely, and consistent with the growth of research activities of the Department. The initiation of an MS program in Engineering Management also appears reasonable at this time. The College makes a strong case for a BS program in Chemical Engineering due to the growth of the pharmaceutical and environmental industries in South Florida and the lack of other programs in the region. Funding proposed by the Board of Regents is insufficient for the high cost of Chemical Engineering laboratory development. Simultaneous planning for a BS program in Chemical Engineering and PhD programs in Civil Engineering and Industrial Engineering appears premature in terms of the budget, space, and facility limitations of the College of Engineering and Design. In view of the number of programs proposed over the next few years, it would be desirable to prioritize these programs, since the initiation of successful new programs must be supported with appropriate budget, space, and facilities.

The College of Engineering and Design, and the individual engineering programs, have Industrial Advisory Boards; however it does not appear that effective use is being made of these advisory boards. It would be beneficial to strengthen the interaction between the engineering programs and local and regional industries through these advisory boards, and, at the same time, increase opportunities for graduates of the engineering programs.

Students

Although the admission standards for freshmen seeking admission to the engineering programs seem appropriate, transfer students admitted to the engineering program require additional faculty effort to bring their level of capability up to the level of those students admitted as freshmen. There is a perception that the admission standards at the community colleges are lower and that there is limited competition among the students. An additional problem is created by the low scores on the Test of English as a Foreign Language (TOEFL) required of international student applicants. Most major institutions require a minimum TOEFL score of 550 and many have found it advisable to require 575. The current FIU requirement of a minimum TOEFL score of 500 appears too low, requiring additional instructional effort on the part of the faculty.

Appropriate numbers of students are enrolled in each of the engineering programs offered in the College of Engineering and Design. The number of degrees granted annually by the various engineering degree programs is appropriate and above the national average, with record numbers of minority engineering graduates.

The passing rate on the Fundamentals of Engineering Examination (sometimes called the Engineer-in-Training or EIT Examination), continues to be below the state and national averages. Such performance may suggest that only students seeking immediate employment take the examination while the stronger students planning to attend graduate school do not. Contributing factors could also be the high proportion of community college transfers, the absence of limited access program status, or the large minority enrollment. It may be appropriate for the faculty to encourage registration as Professional Engineers by becoming registered and by offering a free intensive review course every semester for those students planning to take the examination.

The growth of the PhD program in Electrical Engineering, and the recent initiation of a PhD program in Mechanical Engineering has resulted in an inadequate number of teaching assistantships. It is particularly important to note that, because of the large Hispanic undergraduate enrollment, the College of Engineering and Design has the opportunity to provide advanced degrees for Hispanic engineers who will be able to serve as role models and faculty for the future, an opportunity not available to most other institutions in the nation. Service as a teaching assistant is a first step toward a career in engineering education, and steps to assure an adequate number of such assistantships for Hispanic graduate students would seem most appropriate.

Budgetary support for teaching assistant stipends appears insufficient, and with the approaching conclusion of the CUP funding in Electrical Engineering, teaching assistant stipends will be non-competitive.

Although the Office of Career Planning and Placement conducts an annual survey of Florida International University graduates, such a survey does not provide adequate tracking of engineering graduates. It would be desirable to initiate a College of Engineering and Design Newsletter and periodic questionnaire to determine the benefit of proposed changes and, perhaps, establish an Academy of Distinguished Graduates as a means of keeping track of former students.

Student participation in engineering professional societies is encouraged and supported. In addition, the various engineering honorary fraternities are available to qualified students.

The advising system has been improved since the last review and is strengthened by the addition of a Director for Academic Support Services for the College. Nevertheless, it would be desirable for the engineering faculty to be involved in all aspects of the advising process for enrolled students.

The multiracial, multicultural student body in engineering provides a unique opportunity for the College to be a leader in minority engineering education for the State and the nation. FIU is designated as a minority institution and graduates more Hispanic engineers than any other institution in the country outside of Puerto Rico. In addition, the engineering program enrolls a significant number of African-American students.

It is recognized that the College of Engineering is successfully addressing one of the nation's critical issues, the recruitment and development of minorities in engineering. The College has an exceptional record of graduating minorities at the BS and MS level, and it appears that record will continue at the PhD level, providing future minority faculty for other institutions in Florida and the nation.

Faculty

The College of Engineering and Design will continue to expand, and the need for additional faculty will continue. While the number of faculty may be adequate for the current enrollment, it is unlikely that the current number will continue to be sufficient in the future.

There appears to be a reasonable faculty balance in terms of age and professorial rank, and there is reasonable diversity in terms of race. The engineering programs have a larger percentage of women, Hispanic, and African-American faculty than most engineering programs around the country. Nevertheless, the College of Engineering and Design should be encouraged to continue its efforts to increase the diversity of its faculty.

As with all engineering schools, some department chairs have a better understanding than others of the requirements for managing a department, as well as the vision needed to lead a department forward. The Civil Engineering chair appears to have too many responsibilities, leading both the Department and the Lehman Center for Transportation. Both positions will require a strong focus to ensure success, and the combined positions for a single individual may be too much. Further, the proposed three year appointment term may preclude full commitment to such a leadership position.

There is an appropriate focus on the quality of instruction through student evaluations, integration of the evaluations into faculty performance reviews, and the number of teaching awards and recognition received by the faculty. In general, the distribution of faculty effort between teaching, research, and service seems appropriate. While teaching and research are readily defined, service is somewhat more subjective. As a consequence, it may be useful to provide clarification of the service expectations and how service may be demonstrated and documented.

There appear to be a number of faculty in the College who are not actively involved in research or other activities related to strengthening the College. Every effort should be made to identify ways in which these faculty might contribute to the progress of the College. Such contributions might include teaching additional courses, developing laboratories, or assuming additional responsibilities for undergraduate recruitment and advising. It may also be desirable to provide incentives for early retirement.

The engineering faculty have developed a strong research program, with significant gains in the past several years. This increase in research funding has led to increased conference publications, journal articles, and research reports. These scholarly publications have brought increased visibility to the College of Engineering and Design, the University, and the state.

A mechanism for stimulating faculty involvement in research and scholarly activity may be the development of a recognition program based on the quality of faculty publications and contributions to research, including research awards, chairs, and professorships. Further, for those faculty who develop patents, copyrighted software, or new technologies which might be licensed to industry, other awards might be made available.

Another form of motivation might be the return of a portion of the indirect cost to the Department and individual principal investigator in the form of discretionary funds for travel, student support, or other similar uses. The total returned to the faculty and chairs should equal the amount returned to the Dean, as a minimum. The entire question of indirect cost return to engineering needs early resolution.

Cooperation within the College and University is encouraged and is demonstrated by the active involvement of faculty teams in the quest for larger research projects. Involvement in interdisciplinary programs such as the Drinking Water Research Center is further evidence of internal cooperation within the College. The College has developed a number of external linkages which benefit the students and faculty, including participation in the NSF-sponsored Gateway Engineering Education Coalition, interaction with local industries through graduate programs on videotape and ITFS, videoconferencing on PictureTEL, participation in the FEEDS program, and a distance learning program with the Magnet School for Engineering. However, support for FIU engineering faculty participation in the FEEDS program seems unreasonably low in comparison with that at most other SUS engineering colleges.

While some funds have been made available for faculty professional development, and the Office of Academic Affairs has funded the acquisition of computers for faculty, these funds are judged to be inadequate for the rate at which the College is growing. With the increase in graduate enrollment, externally funded research, and visibility of the faculty, additional funds will be required to improve and sustain faculty development.

Faculty salaries appear to be comparable to those at other institutions with similar levels of research funding and enrollment levels. Unfortunately, salary compression occurs as a result of competition for highly qualified younger faculty at higher salaries than some current faculty, a situation also being experienced by other institutions. As a consequence, salary adjustment funds are needed to resolve the salary compression problems for many of the productive senior faculty.

Facilities and Resources

The anticipated new building for engineering will help alleviate the current laboratory and office space shortage in the College; however, Computer Science has been assigned to the building along with Engineering, reducing the available space to Engineering. Computer Science should be integrated into the College of Engineering and Design, or removed from the same building as Engineering. It appears that the differences in management style and performance expectations between Computer Science and Engineering have led to a perceived difference in treatment of the faculty. Further, by the time the anticipated building is complete, the undergraduate and graduate engineering enrollments and associated externally funded research will have increased to the point that the lack of space will continue to be a problem.

Office space for faculty appears inadequate, and faculty in the same department are not all housed together, precluding the synergism which occurs in the growth and development of an engineering program. Based on a review of the documentation provided and discussion with the faculty, office space for teaching assistants is nonexistent. There is no commons room space for faculty or students in the College of Engineering and Design, although each engineering department has a conference room, or access to a conference room.

Classroom space appears adequate at this time; however the continuing increase in undergraduate engineering enrollment may strain this space in the near future. Instructional laboratory space is marginally adequate to inadequate for the current student body, and substantially below typical undergraduate instructional laboratory space found at other comparable institutions. Increased undergraduate enrollment will further exacerbate the problem of space allocation.

Laboratory space for research is marginal to inadequate, and as sponsored research grows, demand for such space will increase.

The quality and quantity of library reference holdings is marginal to inadequate, although some references are available at the University of Miami. While the quality of the journal holdings may be adequate, the quantity of engineering journals is inadequate for the engineering programs currently being offered. In most cases, journal references must be obtained through interlibrary loan. Overall, the quality and quantity of the library collection is inadequate to support the engineering programs being offered.

While the College of Engineering and Design makes computer facilities available to students on weekdays, such facilities are not available late in the evening or during the weekend. The computer facilities are marginally adequate with limited up-to-date equipment, and the number of dial-up ports is insufficient to allow adequate access to the facilities after hours. Further, the specialized software needed for some instructional activities is not available through dial-up connections. Modern computational facilities are essential for a strong engineering program, and the present inventory of hardware and software appears inadequate to meet the needs of a quality engineering program.

The initiation of a computer access fee, charged each engineering student each semester, would provide some financial support to upgrade and maintain the hardware and software, as well as provide personnel support to keep the computer facilities open for a longer period of time. Such a fee has been instituted at a number of institutions throughout the country.

The inventory of equipment in the College of Engineering and Design is marginal at best, in part because it is a young institution, and in part because inadequate funds were provided for the transition from technology to engineering. Further, there are insufficient funds for adequate maintenance and modernization of the laboratory facilities on a continuing basis, as required by ABET engineering accreditation criteria.

In view of the limited resources available for laboratory acquisitions, it may be appropriate to institute a College of Engineering and Design Laboratory Fee for each laboratory course, to be assessed to each student each semester as a means of providing sufficient support for laboratory modernization. Such a fee has been instituted at a number of other engineering schools to assist with laboratory modernization.

Although the self-study documentation notes that the College has sufficient office expenses for operation when considering both the formula budgeted expenses and support from research grants and contracts, reliance on research grants as a means for providing office expenses for operation is unreliable and should not be used to support the instructional program. The number of permanently funded engineer/technician support personnel is insufficient for the engineering programs offered. The use of research funded support personnel for instructional and other academic activities suggests that the institution is not providing the level of support personnel necessary for the current instructional programs.

Responses to Previous Program Review Recommendations

The most recent SUS Engineering Education Program Review (1988) contained six recommendations for the FIU College of Engineering and Design. These are listed below, along with the actions taken in response to each recommendation.

1. The FEEDS facility should be restored in the planning for the new building. Further funding of FIU as a primary center should depend on its future performance and commitment to the FEEDS Program.

   Response: Currently, the FEEDS facility consists of one classroom/studio in the VH building, which formerly housed engineering. FEEDS has renovated this classroom and installed a new, high-speed fax machine and a document camera. An additional classroom/studio in the VH building has been fully equipped by FIU to transmit live classes via videoteleconference technology. This facility is shared by all academic programs at FIU, including FEEDS. The College of Engineering and Design has shown a commitment towards the expanded mission of FEEDS and the Board of Regents has approved FIU/FEEDS as a primary center; however, funding is not commensurate with the current FIU role in the program.

2. A facility renovation plan should be developed for renovation of the old building to take place during the 1990-91 academic year.

   Response: The old building, VH, was renovated and now houses faculty offices and laboratories for Civil and Environmental Engineering. The facilities will go through additional renovation and changes in the design of Engineering II, with the possible relocation of Civil and Environmental Engineering to Engineering II and designation of VH for programs that require high bay and wet laboratory areas.

3. A separate bachelor's degree program leading to a BS in Computer Engineering should be established out of the present Computer Engineering specialization within the Electrical Engineering Degree Program. The department should be named Electrical and Computer Engineering Department and offer the two separate (but overlapping) degree programs.
   Response: This recommendation has been implemented with the establishment of Computer Engineering. In 1993 the program was reviewed and received ABET accreditation.
4. The master's degrees in Industrial and Mechanical Engineering should be approved as soon as possible after the accreditation visit if it appears that accreditation will be granted.
   Response: Both bachelor's programs received accreditation, and Master's degree programs were implemented. In addition, a PhD in Mechanical Engineering was implemented in 1994.
5. Consideration of Chemical Engineering (or other engineering) degree programs at FIU should be delayed and restudied after the move into the new building and the renovation plan are completed. Priority should be given to the space needs of existing departments and their future research space needs.
   Response: To date, an undergraduate Chemical Engineering program has not been implemented, although the College still sees this as a high priority, concurrent with development of Engineering II. Initiation of a Chemical Engineering program is expensive, and it is not clear that sufficient

resources or space will be made available to initiate such a program, particularly since the current engineering programs are underfunded and understaffed with marginal to inadequate laboratory and office space.

6. The College of Engineering should be a separate administrative unit composed only of engineering or engineering-related departments and programs.

   Response: While the recommendation has still not been fully implemented, the present structure provides a degree of autonomy with an Associate Dean to handle the tasks associated with the three non-engineering programs: Architecture, Landscape Architecture, and Construction Management. Other non-engineering programs in the College, such as Apparel Management, have been terminated. Nevertheless, separation of the College of Engineering from the School of Design is still believed appropriate and merits implementation.

Thus, a majority of the recommendations noted in the previous program review have been addressed during the past five years; however, the issues with regard to the FEEDS program, the consideration of a baccalaureate Chemical Engineering Program, and the establishment of the College of Engineering as a separate administrative unit have not been fully resolved.

Strengths and Needs

The College of Engineering and Design at FIU has made significant progress since the last Board of Regents review; its strengths include the following.

1. The College offers strong, accredited undergraduate engineering programs.
2. The faculty are well qualified, and the junior faculty are particularly energetic, productive, and actively involved in appropriate teaching, research, and scholarly activities. They also receive high marks from the students for their caring nature.
3. The College serves a diverse student body with one of the highest proportions of underrepresented minorities in the nation, a number of whom continue on for advanced degrees.
4. The growing graduate research program exceeds those of other peer institutions on a per faculty basis.

Weaknesses of the FIU engineering programs observed by the consultants are as follows.

1. There is a current shortage of both instructional and research space, which will not be fully relieved by the new building if non-engineering units are also housed there.
2. Instructional laboratory equipment and computer facilities are badly in need of modernization and expansion, along with additional support staff.

3. Salary compression is a serious problem for productive senior faculty.
4. Library holdings are inadequate to support strong graduate instructional and research programs in engineering.
5. Departmental operating funds are inadequate and must be supplemented by research funding to the extent that some research funds may be subsidizing the instructional program.
6. The advising process for freshman and sophomore students needs to be strengthened by direct and active involvement of engineering faculty.
7. The number of teaching assistantships is inadequate to support the engineering programs, and the stipends for such positions are not competitive.
8. Certain admission requirements need to be strengthened. Minimum TOEFL scores for international applicants are too low to assure adequate English language communication ability, and a number of community college transfer students seem poorly prepared to begin engineering study.
9. The College does not appear to be taking full advantage of the assistance that could be provided through more active involvement of its Industrial Advisory Board.
10. Support for FIU engineering faculty participation in the FEEDS system seems quite low in comparison with that for most other SUS engineering colleges.

Recommendations

The consultants offer the following specific recommendations regarding the College of Engineering and Design at Florida International University.

1. The consultants recommend that additional space be made available to meet the teaching and research needs of the College of Engineering and Design. With the continuing growth of enrollment and graduate research programs there is an immediate need for additional contiguous space. The addition of a new building in the near future will be beneficial but insufficient, and the inclusion of other entities in the building will reduce its usefulness for engineering instruction and research activities.
2. The consultants recommend that additional funds be made available for the acquisition of instructional laboratory equipment and computer support. The instructional laboratory facilities have not been modernized and many of the current facilities are antiquated and inoperative. No funds are available for modernization, nor are funds available to hire adequate staff to maintain the laboratories, as required by engineering accreditation criteria.
3. The consultants recommend that salary funds be made available to assist the College in resolving the problem of salary compression. While the College has attracted outstanding junior faculty, the salary requirements for these junior faculty have exceeded the level of current productive

faculty. Such inequities, if permitted to continue, will lead to disillusionment and possible diminution of the current outstanding morale in the College.

4. The consultants recommend that the advising process for both new and transfer students be reviewed and strengthened. Although an advising process is in place, it does not seem to meet the needs of those students choosing to pursue engineering, particularly during the first two years. It would be desirable to have engineering faculty involved in the advising process from the first day of matriculation.

5. The consultants recommend that the indirect cost recoveries from engineering research grants and contracts be shared with principal investigators and departments, as well as the College. Many institutions provide discretionary funds to principal investigators, department heads, and deans, in proportion to the indirect costs recovered. These funds serve as an incentive to pursue funding and conduct research, and are used to support travel, graduate students, equipment acquisition, and other activities that advance the mission of the engineering program.

6. The consultants recommend that the College be granted support for one or more Eminent Scholar positions in keeping with the growing significance of its research programs. In order to attract and retain outstanding faculty, as well as strengthen the College, it would be desirable for the College to attract one or more eminent senior faculty members.

7. The consultants recommend that the engineering faculty work with the students to improve performance on the Fundamentals of Engineering Examination. Inasmuch as only a few of the faculty are registered as Professional Engineers, it would be desirable for appropriate faculty to become registered as positive role models for the students. Further, it would be beneficial if, throughout the year, the faculty were to encourage the students to become registered and to provide free refresher or review courses for students preparing for the Fundamentals of Engineering Examination.

8. The consultants recommend that the College and University review the current TOEFL requirements. Most major institutions require a minimum TOEFL score of 550 and many have found it advisable to require 575. The current FIU requirement of a minimum TOEFL score of 500 seems too low, requiring additional instructional effort on the part of the faculty. In the experience of the consultants, students with scores of 550 or below frequently have difficulty functioning in an English-speaking environment.

9. The consultants recommend that the engineering faculty review the current credit requirements for the MS degree. Credit requirements for the MS range from 30 credits (no thesis) to 36 credits (with thesis). In order to be competitive and consistent with peer institutions, it would be desirable to have similar degree requirements.

10. The consultants recommend that the College and its departments revitalize and work more actively with their Industrial Advisory Boards. Although the College and engineering departments have industrial advisory boards, it does not appear that they have been used effectively to benefit the College. It would be desirable to have frequent meetings, solicit used equipment for research and instructional use, solicit support for endowed professorships and chairs, and seek assistance in the development of industrial research projects.

11. The consultants recommend that the College review the level of support for faculty involvement in the FEEDS program. While the engineering faculty are actively involved in the FEEDS program, it does not appear that state support for the facilities and programs at FIU is consistent with that at other state institutions involved with the program.

12. The consultants recommend that the College review the articulation agreements with community colleges. In view of the large number of transfer students to the engineering programs at FIU, and the perceived shortcomings in the preparation of many of these students, it may be desirable to review the articulation agreements in terms of the requirements necessary for admission to the engineering programs.

University of North Florida

Charles E. Smith

The UNF Electrical Engineering Program was placed under the administration of the Jacksonville campus, effective August 7, 1992, and has not yet been evaluated for accreditation by the Engineering Accreditation Commission (EAC) of the Accreditation Board for Engineering and Technology (ABET). The Department of Electrical Engineering is currently preparing for an EAC/ABET site visit in Fall, 1995.

The Program was originally established in 1987 as a joint effort between The University of Florida (UF) College of Engineering and UNF. As a result, the program was not evaluated as a separate program in the 1988 Engineering Program Review. The Florida Board of Professional Engineers (PE Board) recognized the graduates of the UNF program while it was hosted by UF, but the program had not been accredited as a satellite program. At the time the UNF program was separated from UF, a limited review of the program by the PE Board was conducted in November 1992, to provide the opportunity for students and graduates of the program to continue to take the Fundamentals of Engineering (FE) Examination, which is the first step toward licensure as a Professional Engineer. The PE Board granted a waiver for students in the UNF program to take the FE Examination based on program quality confirmed by the evaluation. The program expects an ABET site visit for purposes of accreditation in Fall 1995.

The transition period between the Summer Session 1992 and the Fall Semester 1992, when UNF first assumed full administrative responsibility for the program, had a negative impact on both student enrollment and faculty retention and created concerns about the stability and viability of the program. The UNF administration has successfully addressed these concerns to ensure continued program integrity, and the results of its efforts are outlined in the following sections of this report.

Educational Program

The UNF Electrical Engineering Department offers an undergraduate program leading to the degree of Bachelor of Science in Electrical Engineering (BSEE) requiring 128 semester hours. Of these, 60 hours of lower division courses are required for full admission into the program, and 68 semester hours are required at the upper level. The total of 128 required credits is within the range specified in the State's *Accountability Measure 12*. These courses are divided into foundation, major, and specialty requirements with a computer design or system design emphasis.

The curriculum is essentially the same as that of the UNF/UF joint program and is well structured to satisfy engineering accreditation requirements. For both specialty options, at least one-half year of humanities and social sciences, one year of a combination of mathematics and basic sciences, and one and one-half years of engineering topics are required, as required by the new ABET criteria for accreditation[8]. The curriculum covers the major emphasis areas in-depth, with provisions for some technical electives.

The upper division program is compatible with community college programs and has specific articulation agreements with many such schools within the region. The students and faculty interviewed reported that community college preparation is generally adequate for engineering studies. However, continuing communication with the community colleges could provide a means to discuss relationships of specific courses, particularly in mathematics and physics, to enhance preparation of students pursuing engineering degrees. Students indicated that support courses on the UNF campus did not always provide adequate preparation for their engineering courses. The Department has already established communications with the support departments, and this needs to continue on a regular basis to insure appropriate preparation of Electrical Engineering students.

The Department of Electrical Engineering in conjunction with the School of Computing Sciences and Engineering has been able to establish a strong, 20 member Engineering Advisory Council. The Council is extremely active in program development, coordination, and recruitment with the community colleges in the Jacksonville area, as well as in resource development to enhance the Electrical Engineering facilities. The Council meets monthly and subcommittees pursue special activities. A major fund raising program is currently underway to provide resources to assist the Department in meeting ABET accreditation requirements.

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[8] One year is considered as 32 semester hours for computation.

The Electrical Engineering Program, which is modeled after the accredited University of Florida program, provides sequential development of the student's knowledge leading to advanced work including analytical and experimental studies. Appropriate computer use is also integrated throughout the program so that the student gains in-depth knowledge of computational applications. The program has a much stronger design component than reported in the 1992 PE Board Review, which recognized only a strong senior design course. Many of the program courses address design. However, to satisfy the current ABET engineering design requirements, it will be necessary to develop an explicit plan for coordinated, sequential development of student design experiences beginning early in the curriculum and culminating in the senior capstone experience.

Oral and written communication requirements were also found to be an integral component of many existing courses. The development of these skills in the engineering students needs to be documented in preparation for the planned ABET evaluation.

Alumni are highly supportive of the quality of the education provided by UNF. In general, they feel that their education is at the least equal to that provided by other schools in the region. Regional employers, representing a diverse group of companies pursuing a wide range of Electrical Engineering applications, were enthusiastic about UNF Electrical Engineering graduates in their workforces. They ranked performance as superior for their UNF employees.

Students

In the Fall of 1994, the UNF Electrical Engineering student body consisted of 114 declared majors with 109 enrolled in courses required in the curriculum. This is an enrollment increase from 55 in the Fall of 1992, following a significant decrease after the program was transferred to UNF. Women constitute twenty per cent of the current enrollment, which is above the national average, but only four per cent are minorities. The program is growing, and demand projections provided by the Advisory Council, along with the large number of requests for information about the program from potential students, suggest that this trend will continue. Faculty anticipate that 20 new students will enroll in the program for the 1995 Spring Semester, on the basis of current applications. Enrollment is appropriate for the existing faculty. However, a projected growth in enrollment to 150 students in three years, according to the Department Strategic Plan, may require additional faculty or teaching assistants to maintain workloads at a reasonable level.

Qualified seniors are employed as undergraduate teaching assistants and paper graders. This arrangement appears to work well, and the faculty express satisfaction with the quality of these student assistants' work. Projected increases in enrollments will create a need for additional laboratory assistants.

The UNF Electrical Engineering Program has been a limited access program since its inception as a joint UF/UNF program. The limitations of access to students for this engineering program were established because of limited availability of facilities, including laboratory space and equipment, faculty, and other resources required for instruction in engineering for a very large student enrollment. Admission is controlled by requiring: (1) a cumulative GPA of at last 2.50, (2) a GPA of at least 2.50 in calculus-based physics, and (3) a GPA of at least 2.50 in three semesters of calculus plus ordinary differential equations. All applicants meeting these requirements are accepted. These standards are judged to be reasonable, based on the experience at many engineering schools that students who fail to meet such requirements have very little chance of earning an engineering degree.

Although the UNF Electrical Engineering Program has the potential to grow somewhat during the next three to five years if resources are available, the facilities and faculty cannot support very large enrollments without significant increases in space, capital equipment, and faculty. Based on current resources, further limitation of access based on a cap on enrollment and/or an increased minimum GPA requirement may be required if enrollment increases above the projected enrollment of 150.

The program is still very new with only a limited record of degrees awarded annually, and not enough graduates have taken the Fundamentals of Engineering Examination to establish valid statistics on licensure examination passing rates. However, the percentage passing rate of recent classes is well above the national average. Retention rates are very high for an engineering program, which may result, at least in part, from an effective central advising system. Students still indicated strongly that they preferred to have a faculty advisor who is familiar with their course work and their profession. The Department should take this into consideration in developing long range plans for student advising.

Although the number of graduates to date is small, placement rates are encouraging, with all graduates placed in an engineering position. The Engineering Advisory Council has been helpful in this placement, and the existing and growing industrial base in the Jacksonville area is a positive contributing factor. Local industry also provides an environment where co-op and intern experiences are readily available, and many students work while pursuing an Electrical Engineering degree at UNF.

The Electrical Engineering Department has sponsored student branches of the Institute of Electrical and Electronics Engineers and the Florida Engineering Society, and the Department is currently seeking to sponsor a Society of Women Engineers chapter. The Department is aware of the need to develop a diverse student body, and plans are being developed to address this issue with additional initiatives in the future. Other student organizations are planned after the program is accredited.

Students interviewed in two separate groups were bright and articulate and appeared to have appropriate backgrounds to pursue engineering degrees. They felt that they were receiving quality education and expressed general satisfaction with their experiences at UNF. Student morale is high, and they appear well prepared to enter the engineering profession after graduation.

Faculty

At the time administration of the Electrical Engineering program was transferred from UF to UNF, several faculty members chose to pursue employment with other units in the State University System or other systems. When the program change was completed, only one tenured faculty member remained with the program. The UNF administration quickly moved to fill vacant positions, and two new associate professors and two new assistant professors have been appointed to the faculty. Candidates for the Chair of the Electrical Engineering Department have been interviewed, and depending on negotiation and acceptance of an employment offer, this position could be filled by January 1995. The administration, with the assistance of the Engineering Advisory Council, plans to establish an endowed faculty position by the 1995 Fall Semester.

Although most of the current faculty members have been with the institution for only a brief time, they have been carefully selected and the quality of this group is high. All faculty members hold doctoral degrees from different, recognized programs within the United States, providing a diverse educational background. Except for one assistant professor, all faculty have previous academic experience at other universities, and four of the five members have industrial experience. Three hold Senior Membership in the Institute of Electrical and Electronics Engineers, and two are registered Professional Engineers. All are active professionally and have published and presented papers within the last three years.

Accreditation criteria for Electrical Engineering programs require at least five experienced, full-time members whose primary commitment is to the program. When the chair position is filled, the faculty will consist of six full-time members. This faculty size satisfies accreditation requirements and should accommodate enrollment growth to 150 students, based on anticipated teaching loads.

Faculty members' areas of expertise cover the core and major courses including digital and computer design, control systems, robotics, power systems, electromagnetics, communication systems, circuits, and electronics. Age and rank distribution is good for a program of this size. The one minority faculty member has already had a positive impact on increasing student diversity, and plans are being developed to increase further the enrollment of underrepresented groups in this program.

At UNF, all faculty are expected to pursue teaching, research and professional development, and service. Typical faculty teaching loads are based on a five-course load consisting of lecture courses and laboratories with a total of 15 to 18 contact hours. Under normal conditions without the necessary preparation for the ABET site visit, this distribution should allow for appropriate faculty work loads. There is continued emphasis by the administration on providing resources and adequate released time for research, scholarship, and service.

As would be expected for such a new faculty, productivity related to research contracts and grants is quite limited. However, the potential for growth in this area is excellent based on faculty expertise and the program location in a large metropolitan area with a growing industrial base. With the support of the Advisory Council, several faculty members have already established links to local industries that may be productive in program and faculty development.

Pending selection of a chair, departmental leadership is exercised by the Dean of the School with the faculty serving as a working committee, led by the tenured associate professor, to oversee departmental operation. The faculty and the Dean have worked together cooperatively and successfully to provide continuity in this program. Morale is high, and the faculty share a goal of building an outstanding Electrical Engineering program at UNF. The Department needs a leader with vision to serve as a focal point for this development, and the qualifications of the candidates considered for the chair position appear to complement well those of the current faculty.

Some concern was expressed by faculty that the distribution of effort required to ensure program development and accreditation might not be consistent with the distribution of effort required to ensure progress toward tenure and promotion. This concern should be addressed clearly by the administration and the new chair to balance these requirements so that both the goals of the Department and the faculty are satisfied.

Faculty salaries are, in general, near or below the Fall 1994 projected weighted average salary levels of the Southern University Group (SUG) used for comparison (see UNF Appendix). This difference is more pronounced at the assistant professor level. Thus, the Department is somewhat vulnerable to loss of faculty to other institutions at a time when stability of faculty is essential for program development.

Limited observations of lecture classes and laboratories along with review of some class notes, laboratory manuals, and student homework indicate that the quality of instruction in Electrical Engineering at UNF is high. Students complimented the teaching of all the faculty members. The students also reported that the Faculty are well liked, tough but fair, and available for consultation outside the classroom. Several of the faculty have already received awards for good teaching.

Facilities and Resources

The Electrical Engineering Department shares facilities in Engineering Hall with the Physics Department. The Department has access to a number of classrooms that are more than adequate to support the program. Laboratories are small in size and somewhat crowded, but adequate for the current enrollment. Increased enrollment and program expansion will require additional laboratory space. All faculty offices are currently occupied and additional office space will be needed when the chair position is filled. The administration has already initiated a renovation program to convert an art studio in Engineering Hall to two office spaces and one control and robotics laboratory, beginning in December 1994. With this addition to the available space, the Department should have sufficient space for growth over the short term. A $13.5 million Science and Engineering Building is currently on the PECO list for initial funding in 1997. This new facility will provide for long term growth of the program.

Most of the equipment of the UNF Department of Electrical Engineering was acquired during the period when UF administered the program. The choice of equipment purchased at that time was excellent, and as a result the Department's laboratories are well equipped with basic instruments to meet the needs of the current enrollment. The instruments are no longer state-of-the-art, but should be adequate for instructional purposes for some time to come. The Department has recently upgraded the general purpose instructional laboratories with modern computers. Two additional laboratories, the classroom laboratory and the microprocessor laboratory, that are based on 286-class technology are being upgraded with 486-based computers. Funds became available this Fall, and these new purchases should be completed before the Spring Semester. In addition, five workstations have been purchased for faculty offices and related faculty research.

With these additions, the Department has adequate laboratory and computer equipment to support the program and its projected growth over the near term. However, the ABET accreditation criteria require that each program have a carefully constructed and functioning plan for the continued replacement, modernization, maintenance, and support of laboratory equipment and facilities. The Department does not have funding for such a plan, and the faculty is concerned that educational quality may deteriorate in the future due to instability of equipment funding. There is no apparent lack for support at this time, but no overall plan supported by an annual budget has been developed.

The office expense budget of the Department is modest and will be marginally adequate if additional resources are made available for faculty development, particularly travel funds. Faculty members are concerned about resources for faculty development, but the UNF administration has indicated continued support in this area. Also, students indicate some shortages of supplies for the laboratories. Some additional expense funds may be required for preparation for the ABET accreditation visit.

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The Department has one technician and one secretary, which should be adequate to support a program of this scale. The current technician is fairly new to the academic setting and is not accustomed to working in such a diverse and demanding environment. The faculty and administration are working with him to provide guidance and training; results are favorable, and the faculty feels that this situation is improving.

Overall, equipment and facilities are judged adequate to support the Electrical Engineering program. Recent and planned equipment additions have the potential to improve greatly the quality of education provided.

The UNF Library is a well established, reasonably funded facility of about 600,000 volumes that serves the University, near-by community colleges, and local area; it is the only major library facility in this region. The library administration appears open to assist all groups on campus. The library uses a computerized on-line catalog, which can be remotely accessed through the campus data center or by local connection into the Florida Information Resource Network (FIRN). The library is planning to provide one-day document access within the near future and is working toward document access on demand. The facility is a well organized and efficient operation with a commitment to assist and provide excellent service to the user.

The collection to support the Electrical Engineering program consists of book volumes as follows: (1) Electrical Engineering-2,000, (2) Computer Science-3,700, (3) Mathematics-4,800, and (4)

Physics-3,700. The reference collection is being improved, and the holdings of Electrical Engineering periodicals have been increased to about 75 titles including major *Transactions of the Institute of Electrical and Electronics Engineers.* Over the past five years approximately $25,000 has been invested in the library collection for this program.

The overall library operation compares well with libraries at institutions of similar enrollment of around 10,000 students. However, the collection available to the Electrical Engineering program is limited because of the program's relative newness. Students and faculty are frequent users of this facility, and both groups indicate that the Electrical Engineering collection is somewhat limited. The library does not budget specific funds for a particular department, but the administration indicates that purchases in the range of $5,000-8,000 annually to support this program are possible, based on requests and needs to maintain currency of the Electrical Engineering collection. Books are purchased in response to demand.

The library collection to support the Electrical Engineering Program is clearly limited, and a one-time addition of funds is needed as the Department seeks ABET accreditation.

Responses to Previous Program Review Recommendations

The most recent SUS Engineering Education Program Review (1988) contained one recommendation for the UNF Electrical Engineering Program, which, at that time, was administered by the

University of Florida College of Engineering. This is listed below, along with the actions taken in response to the recommendation.

1. No new engineering programs should be considered at UNF until the present program has reached maturity and a firm demand has been demonstrated.
   Response: No new engineering programs have been initiated at UNF, and, to the consultants' knowledge, none are planned for the near future.

Strengths and Needs

The following were judged to be strengths of the Electrical Engineering Program at the University of North Florida.

1. The UNF Electrical Engineering Program has been well planned with the goal of preparing baccalaureate level engineers for entry level positions in industry.
2. The curriculum emphasizes the industrially important topics of digital design and system design, and is designed to guide the student through an orderly path to achieve the objectives of the program.
3. The program appears to satisfy the minimum requirements of ABET engineering accreditation criteria and applicable program criteria, with certain correctable exceptions.
4. The program including curriculum, facilities, and faculty compares favorably with those at peer institutions with similar enrollments in the southern region and the nation.

5. A strong institutional commitment to the Electrical Engineering Department is evidenced by the sincere appreciation of the Department by all levels of administration. Administrative communication is excellent from the student body to the UNF President, with cooperative support at every level to obtain solutions to almost any problem encountered.
6. The Department has been successful in recruiting new qualified faculty and students. This has lessened the concerns of stability and provides a strong and healthy program for growth in the future.

Major unmet needs of the UNF Electrical Engineering Program include the following.

1. Because of relatively low salaries, especially at the assistant professor level, the Electrical Engineering Department is somewhat vulnerable to loss of faculty to other institutions at a time when stability of faculty is essential for program development.
2. The program lacks a long range plan for the continued replacement, modernization, and maintenance of laboratory equipment and facilities with an annual equipment budget.
3. Both students and faculty report that the Electrical Engineering collection of the UNF library is limited.
4. Faculty expressed some uncertainty regarding the expectations for their professional and scholarly contributions. There was particular concern that the distribution of effort

needed for program development and accreditation might not be consistent with the distribution of effort required to ensure progress toward tenure and promotion.

Recommendations

The UNF Electrical Engineering Program has shown remarkable development over the past two years, and its future appears bright. However, to help ensure success, the consultants offer the following recommendations.

1. The consultants recommend that a long-range Master Plan be developed for overall operation of the Electrical Engineering Program to meet the growing needs in the Northeast Florida area. This plan should address projected enrollments, recruitment and demand, faculty and curriculum development, and resource requirements to provide guidance for the Department and the administration in the development of the Electrical Engineering Program as UNF moves into the 21st century.
2. The consultants recommend that the Electrical Engineering faculty develop an explicit plan for coordinated, sequential development of student design experiences beginning early in the curriculum and culminating in the senior capstone design experience. Plan components should be documented in a design exhibit, including samples of student work, for ABET evaluation.

3. The consultants recommend that the Electrical Engineering faculty develop a plan to demonstrate the successful development of oral and written communication skills of the students in the Electrical Engineering program. Plan components should be documented in course descriptions for ABET evaluation.
4. The consultants recommend that the UNF administration continue actions to assure that Electrical Engineering faculty salaries and benefits are competitive.
5. The consultants recommend that the Department of Electrical Engineering, with support from the UNF administration, develop a long range plan for continued replacement, modernization, and maintenance of laboratory equipment and facilities, supported by an annual equipment budget.
6. The consultants recommend that funding be provided for the addition of 750 Electrical Engineering books to the library collection to improve the quality of collection support for this specific program[9].

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[9] Based on $50-80 average price of books to be acquired in this discipline.

Appendix to University of North Florida Report
Salary Survey Institutions, Southern University Group

The projected salary data quoted in the UNF report are based on annual data collection by the institutional research offices of the institutions comprising the Southern University Group. Recent participants in Southern University Group salary study are listed below:

Mississippi State University
University of Alabama
Texas A & M University
University of Mississippi
University of Kentucky
University of South Carolina
University of Southern Mississippi
University of Alabama at Birmingham
University of North Carolina at Chapel Hill
University of Georgia
University of Maryland at College Park
Florida State University
University of Oklahoma
North Carolina State University at Raleigh
University of Arkansas at Fayetteville
University of Virginia
Virginia Polytechnic Institute and State University
Georgia State University
Texas Tech University
West Virginia University
University of Houston
Louisiana State University
University of Texas at Austin
Auburn University
Oklahoma State University
University of Tennessee at Knoxville
Clemson University
Georgia Institute of Technology

APPENDICES

APPENDIX A

1994 Engineering Program Review Consultants

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Appendix B1: State University System Undergraduate Engineering Enrollments, 1989-93

Institution	Undergraduate Enrollment								
and	Total	Men		Women		African American		Hispanic	
Year		No.	Per Cent	No.	Per Cent	No.	Per Cent	No.	Per Cent
Fall 1989									
FAMU	420	317	75.5	103	24.5	377	89.8	9	2.1
FSU	969	801	82.7	168	17.3	111	11.5	57	5.9
FAMU/FSU	1,389	1,118	80.5	271	19.5	488	35.1	66	4.8
FAU	642	530	82.6	112	17.4	39	6.1	89	13.9
FIU	962	836	86.9	126	13.1	86	8.9	526	54.7
UF	2,936	2,502	85.2	432	14.7	172	5.9	229	7.8
UCF	1,912	1,622	84.8	290	15.2	51	2.7	126	6.6
UNF	0	0		0		0		0	
USF	2,142	1,772	82.7	370	17.3	119	5.6	171	8.0
TOTAL	**9,983**	**8,380**	**83.9**	**1,601**	**16.0**	**955**	**9.6**	**1,207**	**12.1**
Fall 1990									
FAMU	525	382	72.8	143	27.2	485	92.4	11	2.1
FSU	1,051	859	81.7	192	18.3	138	13.1	56	5.3
FAMU/FSU	1,576	1,241	78.7	335	21.3	623	39.5	67	4.3
FAU	629	532	84.6	97	15.4	59	9.4	91	14.5
FIU	1,031	902	87.5	129	12.5	81	7.9	576	55.9
UF	2,983	2,529	84.8	454	15.2	179	6.0	240	8.0
UCF	2,001	1,646	82.3	355	17.7	52	2.6	143	7.1
UNF	0	0		0		0		0	
USF	2,047	1,683	82.2	364	17.8	134	6.5	158	7.7
TOTAL	**10,267**	**8,533**	**83.1**	**1,734**	**16.9**	**1,128**	**11.0**	**1,275**	**12.4**
Fall 1991									
FAMU	678	486	71.7	192	28.3	633	93.4	15	2.2
FSU	1,081	862	79.7	219	20.3	151	14.0	50	4.6
FAMU/FSU	1,759	1,348	76.6	411	23.4	784	44.6	65	3.7
FAU	721	611	84.7	110	15.3	73	10.1	88	12.2
FIU	1,074	929	86.5	145	13.5	86	8.0	619	57.6
UF	2,931	2,447	83.5	484	16.5	156	5.3	238	8.1
UCF	1,982	1,632	82.3	350	17.7	61	3.1	182	9.2
UNF	0	0		0		0		0	
USF	1,989	1,639	82.4	348	17.5	142	7.1	186	9.4
TOTAL	**10,456**	**8,606**	**82.3**	**1,848**	**17.7**	**1,302**	**12.5**	**1,378**	**13.2**
Fall 1992									
FAMU	737	499	67.7	238	32.3	691	93.8	7	0.9
FSU	1,125	891	79.2	234	20.8	173	15.4	52	4.6
FAMU/FSU	1,862	1,390	74.7	472	25.3	864	46.4	59	3.2
FAU	810	700	86.4	110	13.6	85	10.5	92	11.4
FIU	1,017	872	85.7	145	14.3	94	9.2	575	56.5
UF	3,018	2,498	82.8	520	17.2	149	4.9	258	8.5
UCF	1,944	1,575	81.0	369	19.0	80	4.1	188	9.7
UNF	55	50	90.9	5	9.1	1	1.8	3	5.5
USF	1,972	1,620	82.2	351	17.8	138	7.0	187	9.5
TOTAL	**10,678**	**8,705**	**81.5**	**1,972**	**18.5**	**1,411**	**13.2**	**1,362**	**12.8**
Fall 1993									
FAMU	792	540	68.2	252	31.8	741	93.6	9	1.1
FSU	1,116	890	79.7	226	20.3	189	16.9	61	5.5
FAMU/FSU	1,908	1,430	74.9	478	25.1	930	48.7	70	3.7
FAU	738	637	86.3	101	13.7	93	12.6	95	12.9
FIU	1,075	915	85.1	160	14.9	120	11.2	603	56.1
UF	3,397	2,809	82.7	587	17.3	190	5.6	294	8.7
UCF	1,981	1,610	81.3	371	18.7	91	4.6	223	11.3
UNF	73	61	83.6	12	16.4	3	4.1	5	6.8
USF	2,009	1,648	82.0	360	17.9	165	8.2	171	8.5
TOTAL	**11,181**	**9,110**	**81.5**	**2,069**	**18.5**	**1,592**	**14.2**	**1,461**	**13.1**

Source: Fall Student Data Course File, 1989-1993, Engineering

Appendix B2: State University System Graduate Engineering Enrollments, 1989-93

Institution and Year	Graduate Enrollment								
	Total	Men		Women		African American		Hispanic	
		No.	Per Cent	No.	Per Cent	No.	Per Cent	No.	Per Cent
Fall 1989									
FAMU	10	8	80.0	2	20.0	4	40.0	0	0.0
FSU	82	75	91.5	7	8.5	2	2.4	2	2.4
FAMU/FSU	92	83	90.2	9	9.8	6	6.5	2	2.2
FAU	176	160	90.9	16	9.1	0	0.0	5	2.8
FIU	118	99	83.9	19	16.1	7	5.9	36	30.5
UF	1,062	943	88.8	118	11.1	22	2.1	26	2.4
UCF	364	304	83.5	60	16.5	5	1.4	13	3.6
UNF	0	0		0		0		0	
USF	406	359	88.4	47	11.6	12	3.0	11	2.7
TOTAL	**2,218**	**1,948**	**87.8**	**269**	**12.1**	**52**	**2.3**	**93**	**4.2**
Fall 1990									
FAMU	9	7	77.8	2	22.2	2	22.2	0	0.0
FSU	119	109	91.6	10	8.4	3	2.5	2	1.7
FAMU/FSU	128	116	90.6	12	9.4	5	3.9	2	1.6
FAU	223	204	91.5	19	8.5	1	0.4	8	3.6
FIU	148	121	81.8	27	18.2	10	6.8	45	30.4
UF	1,146	1,019	88.9	127	11.1	32	2.8	29	2.5
UCF	372	313	84.1	59	15.9	5	1.3	10	2.7
UNF	0	0		0		0		0	
USF	438	383	87.4	55	12.6	9	2.1	23	5.3
TOTAL	**2,455**	**2,156**	**87.8**	**299**	**12.2**	**62**	**2.5**	**117**	**4.8**
Fall 1991									
FAMU	17	13	76.5	4	23.5	11	64.7	0	0.0
FSU	120	108	90.0	12	10.0	1	0.8	3	2.5
FAMU/FSU	137	121	88.3	16	11.7	12	8.8	3	2.2
FAU	242	223	92.1	19	7.9	3	1.2	10	4.1
FIU	158	133	84.2	25	15.8	8	5.1	50	31.6
UF	1,275	1,134	88.9	140	11.0	25	2.0	39	3.1
UCF	497	406	81.7	91	18.3	11	2.2	21	4.2
UNF	0	0		0		0		0	
USF	481	417	86.7	63	13.1	12	2.5	18	3.7
TOTAL	**2,790**	**2,434**	**87.2**	**354**	**12.7**	**71**	**2.5**	**141**	**5.1**
Fall 1992									
FAMU	19	15	78.9	4	21.1	13	68.4	1	5.3
FSU	123	109	88.6	14	11.4	0	0.0	2	1.6
FAMU/FSU	142	124	87.3	18	12.7	13	9.2	3	2.1
FAU	280	249	88.9	31	11.1	2	0.7	18	6.4
FIU	180	157	87.2	23	12.8	18	10.0	56	31.1
UF	1,372	1,228	89.5	144	10.5	32	2.3	41	3.0
UCF	598	483	80.8	115	19.2	10	1.7	23	3.8
UNF	0	0		0		0		0	
USF	562	483	85.9	79	14.1	19	3.4	33	5.9
TOTAL	**3,134**	**2,724**	**86.9**	**410**	**13.1**	**94**	**3.0**	**174**	**5.6**
Fall 1993									
FAMU	19	17	89.5	2	10.5	12	63.2	1	5.3
FSU	138	120	87.0	18	13.0	1	0.7	2	1.4
FAMU/FSU	157	137	87.3	20	12.7	13	8.3	3	1.9
FAU	254	223	87.8	31	12.2	2	0.8	13	5.1
FIU	199	166	83.4	33	16.6	12	6.0	70	35.2
UF	1,358	1,197	88.1	161	11.9	35	2.6	49	3.6
UCF	660	538	81.5	122	18.5	12	1.8	23	3.5
UNF	0	0		0		0		0	
USF	592	507	85.6	85	14.4	21	3.5	40	6.8
TOTAL	**3,220**	**2,768**	**86.0**	**452**	**14.0**	**95**	**3.0**	**198**	**6.1**

Source: Fall Student Data Course File, 1989-1993, Engineering

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Appendix B3: State University System Total Engineering Enrollments, 1989-93

Institution	Total Enrollment								
and	Total	Men		Women		African American		Hispanic	
Year		No.	Per Cent	No.	Per Cent	No.	Per Cent	No.	Per Cent
Fall 1989									
FAMU	430	325	75.6	105	24.4	381	88.6	9	2.1
FSU	1,051	876	83.3	175	16.7	113	10.8	59	5.6
FAMU/FSU	1,481	1,201	81.1	280	18.9	494	33.4	68	4.6
FAU	818	690	84.4	128	15.6	39	4.8	94	11.5
FIU	1,080	935	86.6	145	13.4	93	8.6	562	52.0
UF	3,998	3,445	86.2	550	13.8	194	4.9	255	6.4
UCF	2,276	1,926	84.6	350	15.4	56	2.5	139	6.1
UNF	0	0		0		0		0	
USF	2,548	2,131	83.6	417	16.4	131	5.1	182	7.1
TOTAL	**12,201**	**10,328**	**84.6**	**1,870**	**15.3**	**1,007**	**8.3**	**1,300**	**10.7**
Fall 1990									
FAMU	534	389	72.8	145	27.2	487	91.2	11	2.1
FSU	1,170	968	82.7	202	17.3	141	12.1	58	5.0
FAMU/FSU	1,704	1,357	79.6	347	20.4	628	36.9	69	4.0
FAU	852	736	86.4	116	13.6	60	7.0	99	11.6
FIU	1,179	1,023	86.8	156	13.2	91	7.7	621	52.7
UF	4,129	3,548	85.9	581	14.1	211	5.1	269	6.5
UCF	2,373	1,959	82.6	414	17.4	57	2.4	153	6.4
UNF	0	0		0		0		0	
USF	2,485	2,066	83.1	419	16.9	143	5.8	181	7.3
TOTAL	**12,722**	**10,689**	**84.0**	**2,033**	**16.0**	**1,190**	**9.4**	**1,392**	**10.9**
Fall 1991									
FAMU	695	499	71.8	196	28.2	644	92.7	15	2.2
FSU	1,201	970	80.8	231	19.2	152	12.7	53	4.4
FAMU/FSU	1,896	1,469	77.5	427	22.5	796	42.0	68	3.6
FAU	963	834	86.6	129	13.4	76	7.9	98	10.2
FIU	1,232	1,062	86.2	170	13.8	94	7.6	669	54.3
UF	4,206	3,581	85.1	624	14.8	181	4.3	277	6.6
UCF	2,479	2,038	82.2	441	17.8	72	2.9	203	8.2
UNF	0	0		0		0		0	
USF	2,470	2,056	83.2	411	16.6	154	6.2	204	8.3
TOTAL	**13,246**	**11,040**	**83.3**	**2,202**	**16.6**	**1,373**	**10.4**	**1,519**	**11.5**
Fall 1992									
FAMU	756	514	68.0	242	32.0	704	93.1	8	1.1
FSU	1,248	1,000	80.1	248	19.9	173	13.9	54	4.3
FAMU/FSU	2,004	1,514	75.5	490	24.5	877	43.8	62	3.1
FAU	1,090	949	87.1	141	12.9	87	8.0	110	10.1
FIU	1,197	1,029	86.0	168	14.0	112	9.4	631	52.7
UF	4,390	3,726	84.9	664	15.1	181	4.1	299	6.8
UCF	2,542	2,058	81.0	484	19.0	90	3.5	211	8.3
UNF	55	50	90.9	5	9.1	1	1.8	3	5.5
USF	2,534	2,103	83.0	430	17.0	157	6.2	220	8.7
TOTAL	**13,812**	**11,429**	**82.7**	**2,382**	**17.2**	**1,505**	**10.9**	**1,536**	**11.1**
Fall 1993									
FAMU	811	557	68.7	254	31.3	753	92.8	10	1.2
FSU	1,254	1,010	80.5	244	19.5	190	15.2	63	5.0
FAMU/FSU	2,065	1,567	75.9	498	24.1	943	45.7	73	3.5
FAU	992	860	86.7	132	13.3	95	9.6	108	10.9
FIU	1,274	1,081	84.9	193	15.1	132	10.4	673	52.8
UF	4,755	4,006	84.2	748	15.7	225	4.7	343	7.2
UCF	2,641	2,148	81.3	493	18.7	103	3.9	246	9.3
UNF	73	61	83.6	12	16.4	3	4.1	5	6.8
USF	2,601	2,155	82.9	445	17.1	186	7.2	211	8.1
TOTAL	**14,401**	**11,878**	**82.5**	**2,521**	**17.5**	**1,687**	**11.7**	**1,659**	**11.5**

Source: Fall Student Data Course File, 1989-1993, Engineering

Appendix C1: State University System Engineering Baccalaureate Degrees, 1989-93

Institution and Year	Bachelor's Degrees Granted								
	Total	Men		Women		African American		Hispanic	
		No.	Per Cent	No.	Per Cent	No.	Per Cent	No.	Per Cent
1989-90									
FAMU	13	11	84.6	2	15.4	6	46.2	1	7.7
FSU	88	72	81.8	16	18.2	7	8.0	6	6.8
FAMU/FSU	101	83	82.2	18	17.8	13	12.9	7	6.9
FAU	161	133	82.6	28	17.4	7	4.3	18	11.2
FIU	139	118	84.9	21	15.1	11	7.9	74	53.2
UF	589	487	82.7	102	17.3	17	2.9	41	7.0
UCF	202	172	85.1	30	14.9	2	1.0	10	5.0
UNF	0	0		0		0		0	
USF	303	261	86.1	42	13.9	11	3.6	26	8.6
TOTAL	**1,495**	**1,254**	**83.9**	**241**	**16.1**	**61**	**4.1**	**176**	**11.8**
1990-91									
FAMU	10	7	70.0	3	30.0	9	90.0	0	0.0
FSU	125	103	82.4	22	17.6	8	6.4	8	6.4
FAMU/FSU	135	110	81.5	25	18.5	17	12.6	8	5.9
FAU	139	117	84.2	22	15.8	6	4.3	24	17.3
FIU	142	120	84.5	22	15.5	6	4.2	75	52.8
UF	565	485	85.8	80	14.2	15	2.7	47	8.3
UCF	294	248	84.4	46	15.6	4	1.4	12	4.1
UNF	0	0		0		0		0	
USF	290	236	81.4	54	18.6	11	3.8	13	4.5
TOTAL	**1,565**	**1,316**	**84.1**	**249**	**15.9**	**59**	**3.8**	**179**	**11.4**
1991-92									
FAMU	24	18	75.0	6	25.0	21	87.5	2	8.3
FSU	152	144	94.7	8	5.3	6	3.9	7	4.6
FAMU/FSU	176	162	92.0	14	8.0	27	15.3	9	5.1
FAU	102	86	84.3	16	15.7	7	6.9	13	12.7
FIU	161	144	89.4	17	10.6	16	9.9	92	57.1
UF	510	437	85.7	73	14.3	19	3.7	52	10.2
UCF	287	243	84.7	44	15.3	1	0.3	13	4.5
UNF	0	0		0		0		0	
USF	294	251	85.4	43	14.6	6	2.0	18	6.1
TOTAL	**1,530**	**1,323**	**86.5**	**207**	**13.5**	**76**	**5.0**	**197**	**12.9**
1992-93									
FAMU	43	33	76.7	10	23.3	33	76.7	3	7.0
FSU	157	117	74.5	40	25.5	12	7.6	7	4.5
FAMU/FSU	200	150	75.0	50	25.0	45	22.5	10	5.0
FAU	114	103	90.4	11	9.6	8	7.0	12	10.5
FIU	192	156	81.3	36	18.8	9	4.7	104	54.2
UF	534	438	82.0	96	18.0	22	4.1	41	7.7
UCF	278	232	83.5	46	16.5	4	1.4	14	5.0
UNF	2	2	100.0	0	0.0	1	50.0	0	0.0
USF	265	217	81.9	48	18.1	7	2.6	27	10.2
TOTAL	**1,585**	**1,298**	**81.9**	**287**	**18.1**	**96**	**6.1**	**208**	**13.1**
1993-94									
FAMU	49	37	75.5	12	24.5	44	89.8	2	4.1
FSU	163	121	74.2	42	25.8	12	7.4	7	4.3
FAMU/FSU	212	158	74.5	54	25.5	56	26.4	9	4.2
FAU	139	121	87.1	18	12.9	20	14.4	18	12.9
FIU	142	127	89.4	15	10.6	5	3.5	72	50.7
UF	537	442	82.3	95	17.7	17	3.2	54	10.1
UCF	304	251	82.6	53	17.4	7	2.3	21	6.9
UNF	6	6	100.0	0	0.0	0	0.0	0	0.0
USF	235	198	84.3	37	15.7	6	2.6	20	8.5
TOTAL	**1,575**	**1,303**	**82.7**	**272**	**17.3**	**111**	**7.0**	**194**	**12.3**

Source: Fall Student Data Course File, 1989-1993, Engineering

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Appendix C2: State University System Engineering Master's/Professional Degrees, 1989-93

Institution	Master's and Professional Degrees Granted								
and	Total	Men		Women		African American		Hispanic	
Year		No.	Per Cent	No.	Per Cent	No.	Per Cent	No.	Per Cent
1989-90									
FAMU	2	2	100.0	0	0.0	2	100.0	0	0.0
FSU	9	7	77.8	2	22.2	1	11.1	0	0.0
FAMU/FSU	11	9	81.8	2	18.2	3	27.3	0	0.0
FAU	47	41	87.2	6	12.8	0	0.0	1	2.1
FIU	10	7	70.0	3	30.0	0	0.0	5	50.0
UF	225	203	90.2	22	9.8	8	3.6	8	3.6
UCF	96	73	76.0	23	24.0	2	2.1	0	0.0
UNF	0	0		0		0		0	
USF	129	108	83.7	21	16.3	3	2.3	4	3.1
TOTAL	**518**	**441**	**85.1**	**77**	**14.9**	**16**	**3.1**	**18**	**3.5**
1990-91									
FAMU	0	0		0		0		0	
FSU	19	18	94.7	1	5.3	0	0.0	1	5.3
FAMU/FSU	19	18	94.7	1	5.3	0	0.0	1	5.3
FAU	60	55	91.7	5	8.3	0	0.0	1	1.7
FIU	27	23	85.2	4	14.8	0	0.0	6	22.2
UF	214	193	90.2	21	9.8	4	1.9	2	0.9
UCF	85	71	83.5	14	16.5	0	0.0	0	0.0
UNF	0	0		0		0		0	
USF	123	108	87.8	15	12.2	4	3.3	7	5.7
TOTAL	**528**	**468**	**88.6**	**60**	**11.4**	**8**	**1.5**	**17**	**3.2**
1991-92									
FAMU	2	1	50.0	1	50.0	1	50.0	0	0.0
FSU	45	43	95.6	2	4.4	1	2.2	1	2.2
FAMU/FSU	47	44	93.6	3	6.4	2	4.3	1	2.1
FAU	48	44	91.7	4	8.3	0	0.0	1	2.1
FIU	31	28	90.3	3	9.7	1	3.2	4	12.9
UF	260	223	85.8	37	14.2	7	2.7	13	5.0
UCF	104	82	78.8	22	21.2	2	1.9	2	1.9
UNF	0	0		0		0		0	
USF	115	93	80.9	22	19.1	2	1.7	9	7.8
TOTAL	**605**	**514**	**85.0**	**91**	**15.0**	**14**	**2.3**	**30**	**5.0**
1992-93									
FAMU	7	6	85.7	1	14.3	5	71.4	0	0.0
FSU	40	35	87.5	5	12.5	1	2.5	1	2.5
FAMU/FSU	47	41	87.2	6	12.8	6	12.8	1	2.1
FAU	50	48	96.0	2	4.0	1	2.0	1	2.0
FIU	34	30	88.2	4	11.8	5	14.7	11	32.4
UF	326	281	86.2	45	13.8	6	1.8	11	3.4
UCF	158	130	82.3	28	17.7	4	2.5	11	7.0
UNF	0	0		0		0		0	
USF	137	115	83.9	22	16.1	5	3.6	6	4.4
TOTAL	**752**	**645**	**85.8**	**107**	**14.2**	**27**	**3.6**	**41**	**5.5**
1993-94									
FAMU	3	3	100.0	0	0.0	2	66.7	0	0.0
FSU	30	27	90.0	3	10.0	0	0.0	2	6.7
FAMU/FSU	33	30	90.9	3	9.1	2	6.1	2	6.1
FAU	74	59	79.7	15	20.3	0	0.0	8	10.8
FIU	23	20	87.0	3	13.0	0	0.0	8	34.8
UF	322	291	90.4	31	9.6	6	1.9	11	3.4
UCF	153	124	81.0	29	19.0	0	0.0	9	5.9
UNF	0	0		0		0		0	
USF	169	134	79.3	35	20.7	6	3.6	14	8.3
TOTAL	**774**	**658**	**85.0**	**116**	**15.0**	**14**	**1.8**	**52**	**6.7**

Source: Fall Student Data Course File, 1989-1993, Engineering

Appendix C3: State University System Engineering Doctoral Degrees, 1989-93

Institution	Doctoral Degrees Granted								
and	Total	Men		Women		African American		Hispanic	
Year		No.	Per Cent	No.	Per Cent	No.	Per Cent	No.	Per Cent
1989-90									
FAMU	0	0		0		0		0	
FSU	0	0		0		0		0	
FAMU/FSU	0	0		0		0		0	
FAU	7	6	85.7	1	14.3	0	0.0	0	0.0
FIU	0	0		0		0		0	
UF	71	68	95.8	3	4.2	0	0.0	1	1.4
UCF	8	8	100.0	0	0.0	0	0.0	0	0.0
UNF	0	0		0		0		0	
USF	7	6	85.7	1	14.3	0	0.0	0	0.0
TOTAL	**93**	**88**	**94.6**	**5**	**5.4**	**0**	**0.0**	**1**	**1.1**
1990-91									
FAMU	0	0		0		0		0	
FSU	2	2	100.0	0	0.0	0	0.0	0	0.0
FAMU/FSU	2	2	100.0	0	0.0	0	0.0	0	0.0
FAU	2	2	100.0	0	0.0	0	0.0	0	0.0
FIU	0	0		0		0		0	
UF	83	70	84.3	13	15.7	4	4.8	2	2.4
UCF	6	4	66.7	2	33.3	0	0.0	0	0.0
UNF	0	0		0		0		0	
USF	10	7	70.0	3	30.0	0	0.0	1	10.0
TOTAL	**103**	**85**	**82.5**	**18**	**17.5**	**4**	**3.9**	**3**	**2.9**
1991-92									
FAMU	0	0		0		0		0	
FSU	0	0		0		0		0	
FAMU/FSU	0	0		0		0		0	
FAU	14	14	100.0	0	0.0	0	0.0	1	7.1
FIU	0	0		0		0		0	
UF	67	59	88.1	8	11.9	1	1.5	1	1.5
UCF	6	5	83.3	1	16.7	0	0.0	2	33.3
UNF	0	0		0		0		0	
USF	18	18	100.0	0	0.0	1	5.6	0	0.0
TOTAL	**105**	**96**	**91.4**	**9**	**8.6**	**2**	**1.9**	**4**	**3.8**
1992-93									
FAMU	0	0		0		0		0	
FSU	1	1	100.0	0	0.0	0	0.0	0	0.0
FAMU/FSU	1	1	100.0	0	0.0	0	0.0	0	0.0
FAU	12	11	91.7	1	8.3	0	0.0	0	0.0
FIU	0	0		0		0		0	
UF	76	72	94.7	4	5.3	4	5.3	1	1.3
UCF	9	7	77.8	2	22.2	0	0.0	1	11.1
UNF	0	0		0		0		0	
USF	6	5	83.3	1	16.7	0	0.0	1	16.7
TOTAL	**104**	**96**	**92.3**	**8**	**7.7**	**4**	**3.8**	**3**	**2.9**
1993-94									
FAMU	0	0		0		0		0	
FSU	2	2	100.0	0	0.0	0	0.0	0	0.0
FAMU/FSU	2	2	100.0	0	0.0	0	0.0	0	0.0
FAU	13	10	76.9	3	23.1	0	0.0	0	0.0
FIU	0	0		0		0		0	
UF	81	78	96.3	3	3.7	1	1.2	0	0.0
UCF	6	5	83.3	1	16.7	0	0.0	0	0.0
UNF	0	0		0		0		0	
USF	11	11	100.0	0	0.0	0	0.0	0	0.0
TOTAL	**113**	**106**	**93.8**	**7**	**6.2**	**1**	**0.9**	**0**	**0.0**

Source: Fall Student Data Course File, 1989-1993, Engineering

Appendix C4: State University System Total Engineering Degrees, 1989-93

Institution	Total Degrees Granted								
and	Total	Men		Women		African American		Hispanic	
Year		No.	Per Cent	No.	Per Cent	No.	Per Cent	No.	Per Cent
1989-90									
FAMU	15	13	86.7	2	13.3	8	53.3	1	6.7
FSU	97	79	81.4	18	18.6	8	8.2	6	6.2
FAMU/FSU	112	92	82.1	20	17.9	16	14.3	7	6.3
FAU	215	180	83.7	35	16.3	7	3.3	19	8.8
FIU	149	125	83.9	24	16.1	11	7.4	79	53.0
UF	885	758	85.6	127	14.4	25	2.8	50	5.6
UCF	306	253	82.7	53	17.3	4	1.3	10	3.3
UNF	0	0		0		0		0	
USF	439	375	85.4	64	14.6	14	3.2	30	6.8
TOTAL	**2,106**	**1,783**	**84.7**	**323**	**15.3**	**77**	**3.7**	**195**	**9.3**
1990-91									
FAMU	10	7	70.0	3	30.0	9	90.0	0	0.0
FSU	146	123	84.2	23	15.8	8	5.5	9	6.2
FAMU/FSU	156	130	83.3	26	16.7	17	10.9	9	5.8
FAU	201	174	86.6	27	13.4	6	3.0	25	12.4
FIU	169	143	84.6	26	15.4	6	3.6	81	47.9
UF	862	748	86.8	114	13.2	23	2.7	51	5.9
UCF	385	323	83.9	62	16.1	4	1.0	12	3.1
UNF	0	0		0		0		0	
USF	423	351	83.0	72	17.0	15	3.5	21	5.0
TOTAL	**2,196**	**1,869**	**85.1**	**327**	**14.9**	**71**	**3.2**	**199**	**9.1**
1991-92									
FAMU	26	19	73.1	7	26.9	22	84.6	2	7.7
FSU	197	187	94.9	10	5.1	7	3.6	8	4.1
FAMU/FSU	223	206	92.4	17	7.6	29	13.0	10	4.5
FAU	164	144	87.8	20	12.2	7	4.3	15	9.1
FIU	192	172	89.6	20	10.4	17	8.9	96	50.0
UF	837	719	85.9	118	14.1	27	3.2	66	7.9
UCF	397	330	83.1	67	16.9	3	0.8	17	4.3
UNF	0	0		0		0		0	
USF	427	362	84.8	65	15.2	9	2.1	27	6.3
TOTAL	**2,240**	**1,933**	**86.3**	**307**	**13.7**	**92**	**4.1**	**231**	**10.3**
1992-93									
FAMU	50	39	78.0	11	22.0	38	76.0	3	6.0
FSU	198	153	77.3	45	22.7	13	6.6	8	4.0
FAMU/FSU	248	192	77.4	56	22.6	51	20.6	11	4.4
FAU	176	162	92.0	14	8.0	9	5.1	13	7.4
FIU	226	186	82.3	40	17.7	14	6.2	115	50.9
UF	936	791	84.5	145	15.5	32	3.4	53	5.7
UCF	445	369	82.9	76	17.1	8	1.8	26	5.8
UNF	2	2	100.0	0	0.0	1	50.0	0	0.0
USF	408	337	82.6	71	17.4	12	2.9	34	8.3
TOTAL	**2,441**	**2,039**	**83.5**	**402**	**16.5**	**127**	**5.2**	**252**	**10.3**
1993-94									
FAMU	52	40	76.9	12	23.1	46	88.5	2	3.8
FSU	195	150	76.9	45	23.1	12	6.2	9	4.6
FAMU/FSU	247	190	76.9	57	23.1	58	23.5	11	4.5
FAU	226	190	84.1	36	15.9	20	8.8	26	11.5
FIU	165	147	89.1	18	10.9	5	3.0	80	48.5
UF	940	811	86.3	129	13.7	24	2.6	65	6.9
UCF	463	380	82.1	83	17.9	7	1.5	30	6.5
UNF	6	6	100.0	0	0.0	0	0.0	0	0.0
USF	415	343	82.7	72	17.3	12	2.9	34	8.2
TOTAL	**2,462**	**2,067**	**84.0**	**395**	**16.0**	**126**	**5.1**	**246**	**10.0**

Source: Fall Student Data Course File, 1989-1993, Engineering

Appendix C5: State University System 5-Year Engineering Degree Totals by Level

	Five-Year Total Degrees Granted, 1989-90 Through 1993-94									
	Total		Men		Women		African American		Hispanic	
Institution and Degree Level	No.	Per Cent at This Level	No.	Per Cent at This Level	No.	Per Cent at This Level	No.	Per Cent at This Level	No.	Per Cent at This Level
Bachelors										
FAMU	139	1.8	106	1.6	33	2.6	113	28.0	8	0.8
FSU	685	8.8	557	8.6	128	10.2	45	11.2	35	3.7
FAMU/FSU	824	10.6	663	10.2	161	12.8	158	39.2	43	4.5
FAU	655	8.5	560	8.6	95	7.6	48	11.9	85	8.9
FIU	776	10.0	665	10.2	111	8.8	47	11.7	417	43.7
UF	2,735	35.3	2,289	35.2	446	35.5	90	22.3	235	24.6
UCF	1,365	17.6	1,146	17.6	219	17.4	18	4.5	70	7.3
UNF	8	0.1	8	0.1	0	0.0	1	0.2	0	0.0
USF	1,387	17.9	1,163	17.9	224	17.8	41	10.2	104	10.9
TOTAL	**7,750**	100.0	**6,494**	100.0	**1,256**	100.0	**403**	100.0	**954**	100.0
Masters										
FAMU	14	0.4	12	0.4	2	0.4	10	12.7	0	0.0
FSU	143	4.5	130	4.8	13	2.9	3	3.8	5	3.2
FAMU/FSU	157	4.9	142	5.2	15	3.3	13	16.5	5	3.2
FAU	279	8.8	247	9.1	32	7.1	1	1.3	12	7.6
FIU	125	3.9	108	4.0	17	3.8	6	7.6	34	21.5
UF	1,347	42.4	1,191	43.7	156	34.6	31	39.2	45	28.5
UCF	596	18.8	480	17.6	116	25.7	8	10.1	22	13.9
UNF	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
USF	673	21.2	558	20.5	115	25.5	20	25.3	40	25.3
TOTAL	**3,177**	100.0	**2,726**	100.0	**451**	100.0	**79**	100.0	**158**	100.0
Doctoral										
FAMU	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
FSU	5	1.0	5	1.1	0	0.0	0	0.0	0	0.0
FAMU/FSU	5	1.0	5	1.1	0	0.0	0	0.0	0	0.0
FAU	48	9.3	43	9.1	5	10.6	0	0.0	1	9.1
FIU	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
UF	378	73.0	347	73.7	31	66.0	10	90.9	5	45.5
UCF	35	6.8	29	6.2	6	12.8	0	0.0	3	27.3
UNF	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
USF	52	10.0	47	10.0	5	10.6	1	9.1	2	18.2
TOTAL	**518**	100.0	**471**	100.0	**47**	100.0	**11**	100.0	**11**	100.0
Total										
FAMU	153	1.3	118	1.2	35	2.0	123	24.9	8	0.7
FSU	833	7.3	692	7.1	141	8.0	48	9.7	40	3.6
FAMU/FSU	986	8.6	810	8.4	176	10.0	171	34.7	48	4.3
FAU	982	8.6	850	8.8	132	7.5	49	9.9	98	8.7
FIU	901	7.9	773	8.0	128	7.3	53	10.8	451	40.2
UF	4,460	39.0	3,827	39.5	633	36.1	131	26.6	285	25.4
UCF	1,996	17.4	1,655	17.1	341	19.4	26	5.3	95	8.5
UNF	8	0.1	8	0.1	0	0.0	1	0.2	0	0.0
USF	2,112	18.5	1,768	18.2	344	19.6	62	12.6	146	13.0
TOTAL	**11,445**	100.0	**9,691**	100.0	**1,754**	100.0	**493**	100.0	**1,123**	100.0

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Source: Fall Student Data Course File, Engineering

APPENDIX D

1994 Engineering Program Review

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APPENDIX E

JOHN W. PRADOS

John W. Prados is Vice President Emeritus and University Professor in the Chemical Engineering Department at The University of Tennessee where he has been employed for the past 40 years, beginning as a graduate assistant in 1953. For 13 years he was a full-time chemical engineering faculty member; then, for the next 20, he held various administrative jobs, including Associate Dean of Engineering, Dean of Admissions and Records, Acting Chancellor of the Knoxville and Martin campuses, Acting Director of Energy Conversion Programs at The University of Tennessee Space Institute, and, from 1973 through 1988, Vice President for Academic Affairs of the statewide university system (Vice President for Academic Affairs and Research, 1981-88). From 1990 to 1993 he was Head of the Chemical Engineering Department. He has been a consultant to the Union Carbide Corporation and Martin Marietta Energy Systems in Oak Ridge, Tennessee, and to a number of universities and state higher education agencies.

Dr. Prados' professional activities include service as a Director of AIChE (American Institute of Chemical Engineers); Executive Councillor of Tau Beta Pi; President and Treasurer of Sigma Xi, The Scientific Research Society; Chair of the Engineering Accreditation Commission, Secretary, and 1991-92 President of ABET (Accreditation Board for Engineering and Technology); and member of the Commission on Colleges of the Southern Association of Colleges and Schools. He has frequently chaired accreditation teams both for ABET and for the Southern Association; he is a Fellow of AIChE and of ABET and is a registered professional engineer in Tennessee.

In his first period of service as a professor, Dr. Prados conducted research and published papers in the areas of flow visualization, thermal diffusion, process dynamics, and mathematical simulation of chemical and nuclear systems. He directed the graduate research of 10 PhD and 31 MS students.

A native Tennessean, Dr. Prados earned the BS in Chemical Engineering at the University of Mississippi and the MS and PhD with majors in chemical engineering at The University of Tennessee. He served for two years as a munitions officer in the United States Air Force. He is married, with three daughters and three granddaughters.